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Uniview

THE MAGAZINE OF THE UNIVERSITY OF WESTERN AUSTRALIA

Living with the land

THE UNIVERSITY OF WESTERN AUSTRALIA

Message from **the Editor**

Welcome to our winter edition of *Uniview*, in which we highlight current research projects focused on agricultural and environmental innovation, technology and protection.

In this issue, we profile some of the many passionate and committed researchers tackling some of the biggest global challenges to food and nutritional security as well as environmental sustainability.

It's also an opportunity for us to showcase some of our emerging researchers who are tackling a diverse range of issues, such as recovering nutrients from food waste to create sustainable agricultural fertilisers, developing prototype machinery for harvesting clover seed, sequestering soil carbon, improving our understanding of reproductive biology in sheep, the economic impact of dung beetles in Australia and identifying disease resistance in canola crops.

I'd encourage you to read about the exciting research happening at our own agricultural and environmental epicentre – UWA Farm Ridgefield in the Wheatbelt location of Pingelly – where The UWA Institute of Agriculture aims to find best-practice solutions for dryland farming systems.

We also feature a fascinating multidisciplinary program to explore the potential of Australian honey – with research expertise drawn from engineering, chemistry, geography, biology and business.

And don't miss our report on fourth-generation farmer, agricultural consultant and graduate Georgia Pugh, who shares her experiences working for a family-run farm as well as an agricultural technology company.

We hope you enjoy this issue of *Uniview*.

Simone Hewett
Associate Director, Corporate Communications

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The University of Western Australia acknowledges that its campuses are situated on Noongar land, and that Noongar people remain the spiritual and cultural custodians of their land, and continue to practise their values, languages, beliefs and knowledge.

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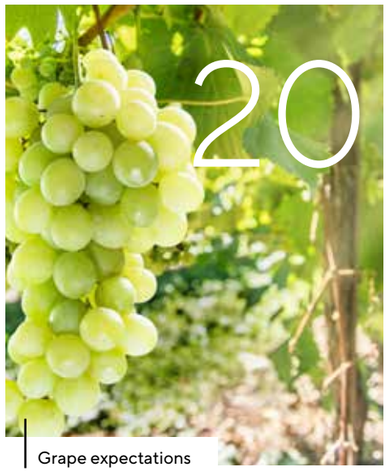

Grape expectations

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Cover page: Sunrise over a farm dam in rural Australia


Professor Amit Chakma, Vice-Chancellor
The University of Western Australia

From the **Vice-Chancellery**

Finding research-based **solutions to global issues**

Living harmoniously with the land is a challenge. How do we define harmony? Is it possible for us to agree upon what harmonious living with the land means?

For millions of people on our planet, living at all is a challenge. According to the United Nations' *State of Food Security and Nutrition in the World 2022* report, around 2.3 billion people, almost a third of the world's population, are "moderately or severely food-insecure".

In 2015 the United Nations set critical goals: 17 objectives that formed a "shared blueprint for peace and prosperity for people and the planet now and into the future". We made promises to ourselves and to the generations who will follow us.

Sustainable Development Goal 2 declares our commitment to "End hunger, achieve food security and improved nutrition and promote sustainable agriculture".

"Zero Hunger" is probably the grandest of all grand challenges: a world free of hunger by 2030. We are not doing well in addressing this challenge effectively.

The number of people enduring severe food insecurity has increased by an estimated 207 million in the past two years, and millions of children are suffering and dying as a result.

This matters to all of us. I am profoundly grateful to the dedicated researchers at UWA who care passionately, think deeply and work with immense energy and dedication to ensure that we are making a difference.

We should be proud that our researchers are ranked in the top 15 in the world for agricultural sciences. They explore and develop solutions to practical problems every day, and their findings inform and guide others. In addition, of our 17 UWA researchers named in the prestigious international 2022 Highly Cited Researcher list, more than half work in agriculture and related areas.

They are tackling some of the biggest global challenges facing agriculture, through research-based solutions to food and nutritional security and environmental sustainability. They do us proud, and they do the world a great service.

Innovative crop breeding method to meet global demand for grains

Crop grain yields are stalling due to climate change, while the global demand for grains is expected to double by 2050.

Plant breeding researchers from The UWA Institute of Agriculture, in collaboration with animal breeding researchers at University of New England (UNE), have developed a novel crop breeding method that achieved very high rates of genetic gain in canola in Australia and Canada.

The research, published in the international journal *Plants*, was funded by the plant breeding company Norddeutsche Pflanzenzucht Hans-Georg Lembke KG (NPZ) as part of its canola pre-breeding research agreement with UWA.

UWA project leader Professor Wallace Cowling said the research had identified a new and innovative method of breeding annual grain crops.

"Our method resulted in a genetic gain in grain yield of up to 4.3 per cent per annum in our global spring canola breeding program since 2016," he said.

In addition to grain yield, the researchers also increased canola seed oil and protein, while rapidly improving resistance to blackleg (Phoma) disease.

UWA canola technicians Jasenka Vuksic and Roz Ezzy in a canola field trial near Rutherglen, Victoria

The researchers used the latest animal breeding technology, based on optimal contributions selection, to combine rapid cycles of genetic selection in canola.

UNE Emeritus Professor Brian Kinghorn said he considered the project to be a valuable extension of his research on optimal contributions selection in animals.

"We developed MateSel software to help animal, tree and crop breeders to optimise the multiple competing objectives of their breeding programs," Emeritus Professor Kinghorn said.

"MateSel in this project was used to optimise decisions to achieve world-leading rates of genetic gain in grain yield and other economic traits in Australia and Canada."

Professor Cowling said the recent publication was the culmination of 10 years of research.

"We asked our partners NPZ in Europe and DL Seeds in Canada to send their latest canola varieties for intercrossing in 2012," he said.

"Every two years we crossed the best offspring and field-tested the progeny in Australia and Canada."

PhD candidates sowing seeds of success

Embarking on a PhD journey may seem like a daunting prospect, but for these four fledgling UWA researchers, the future is bright.

Ruby Wiese recently received the AW Howard Memorial Trust Research Fellowship, while James O'Connor, Alistair Hockey and George Mercer are recipients of the AW Howard Memorial Trust's Tim Healey Memorial Scholarship.

Currently midway through his project, Mr O'Connor said the scholarship would significantly impact his research journey.

"It will provide me with the necessary financial support to further my research and invest in higher risk, higher reward research outputs in order to further scientific knowledge within the field," he said.

Mr O'Connor is exploring innovative solutions to recover vital nutrients from food waste to create sustainable fertilisers for agriculture.

"My research involves a thorough comparison of various food waste valorisation products, such as compost, anaerobic digestate and acidified digestate, to determine their agronomic value," he said.

Mr Hockey is researching the genetic and genomic barriers between chickpea and its close wild relative *Cicer echinospermum*.

"I believe that my research can make a positive impact on food security in rapidly changing environments and in the conservation of an important wild species."

Ms Wiese's PhD is part of a larger AgriFutures-funded project aiming to develop prototype machinery for harvesting subterranean clover seed.

The new design will ideally overcome the inefficiencies and environmental damage problems associated with the current harvest process.

UWA PhD candidates James O'Connor, Alistair Hockey, Ruby Wiese and George Mercer

"This Fellowship is particularly meaningful, because AW Howard pioneered the use of sub clover as a sown pasture legume," she said.

Now 18 months into his PhD within the ARC Training Centre for the Transformation of Australia's Biosolids Resource, Mr Mercer said his project dealt with the 'tricky business' of sequestering soil carbon.

"Biosolids (the solid by-product of the wastewater treatment process) come packed with carbon and nutrients that trickle-feed the entire plant-soil system," he said.

"By assessing the biological response of plants and soil microbes to transformed biosolid products, we can help to identify and utilise pathways that are most likely to store carbon in the soil for the long term."

Unexpected benefits from pollinators at edges of second-growth forests

A new study has found open, light-filled forest edges support more flowers and pollinators than the dark interior of second-growth forests and the value of these areas should not be overlooked.

The study, *Forest edges increase pollinator network robustness to extinction with declining area,* by researchers at UWA, Zhejiang University in China and CSIRO — Australia's national science agency, was published in *Nature Ecology & Evolution.*

Researchers found the interior of dense secondary forests harboured a low diversity of flowering native plants and insect pollinator species – in stark contrast to the complex patchiness of gaps and clearings found in natural forests, where higher light levels stimulated abundant floral resources that supported diverse plant-pollinator networks.

Co-author Professor Raphael Didham, from UWA's School of Biological Sciences and CSIRO, said most other studies had focused on the effects of habitat loss on pollinator communities in open habitat systems.

"In our research, we found that forest edges have unexpected beneficial effects on pollinator networks by buffering floral resource availability in declining forest areas," Professor Didham said.

Over three years, in the Thousand Island Lake region of eastern China, the team recorded almost 20,000 pollination interactions between 313 insect species and 68 flowering plant species along the edge and interior gradients of 41 regenerating forest islands and 16 mainland reference sites.

The research found plant richness and floral resource availability declined with decreasing forest area at both interior and edge sites, but surprisingly edges maintained 10-fold higher pollinator abundance and richness regardless of area loss.

"In areas where there is little old-growth forest left and a strong move toward reforestation – for erosion control, carbon offsetting or biodiversity conservation – care is needed to avoid pollinator loss," Professor Didham said.

"Dense closed secondary forests do not have the right environmental conditions or floral resources for many pollinators. This does not mean that forest fragmentation or edge creation are 'good' for biodiversity, in general, but they do have an unexpected beneficial role to play in regenerating forests."

The findings suggest tree-planting initiatives need to diversify spatial planning to build better forests for pollinators.

GROWING AUSTRALIA'S FUTURE

By Liz McGrath

UWA's Plant Growth Facility is more than just a practical growing site for researchers to carry out experiments. It's a hothouse for turning the seeds of bright ideas into reality.

In the sprawling nest of greenhouses on the eastern side of UWA's Crawley campus, a diverse collection of plants sits in various stages of growth.

Crops, seedlings, succulents, perennials, botanicals and various other forms of flora are cultivated under tightly controlled conditions, as researchers study everything from soil biology to noxious weed control and mine site rehabilitation.

"At any one time we can have a plant disease trial going on, plant viruses being investigated by a PhD student, a researcher looking at faba beans; one looking at canola crop yields and someone else looking at the biological processes taking place in soil," says UWA Plant Growth Precinct Manager Robert Creasy.

The facility he manages with colleague Bill Piasini provides a high-quality, functional site for plant experiments, with users able to manipulate light quality, temperature, water, nutrients and soil composition, effectively eliminating the variability found in nature.

As every plant scientist knows only too well, the natural world can be unpredictable and complex, even at the best of times.

"We see this all the time," Mr Creasy says. "I was contacted recently by a researcher who was breeding heat-tolerant crops and all his field crops had been washed out in the New South Wales floods, which was devastating.

"The thing about breeding is it could have been that one seed or that one plant that was the culmination of a 10-year research program.

"We were able to grow his field crops at the right temperature in our facility, so that he could achieve the quality of seed he was after."

The Plant Growth Facility is available to all students and staff

For Spanish-born Research Fellow Dr Maria Pazos Navarro from UWA's School of Agriculture and Environment, who works on exploiting new technologies to solve agricultural problems, the Plant Growth Facility is like a second home.

"My background is in genetic plant modification – in vitro tissue culture techniques, molecular and cell biology, plant physiology and plant breeding, focusing on legumes," she says.

"I'm currently working on new highly efficient genetic transformation protocols. I'm testing different types of light to enhance transformation efficiency and I'm on site every week when my experiments are running.

"The beauty of the facility is that it runs all year round – it's a very supportive environment, and it allows researchers the ability to be entrepreneurial, to branch out and build up their research portfolio."

Research Fellow Dr Maria Pazos Navarro

> When you look through the windows, what looks like a simple plant in a glasshouse might be someone's future career. Ten years of hard work may have gone into getting that plant to exactly where it is right now.

Crops grown in the Plant Growth Facility

Ideally positioned to tease apart the questions that need answering

The 19 greenhouses, eight phytotrons (sophisticated greenhouses where plants can be grown under environmental control), 29 plant growth rooms and eight plant growth cabinets at UWA are supported by an autoclave, soil storage areas and sterilisation equipment, ancillary equipment storage spaces and a deionised water production facility.

There are preparation and harvest labs, drying and weighing rooms, with some of the facilities certified for biosecurity activities, such as working with genetically modified plants or quarantined species.

"One advantage we have is that our facilities are close to most of the major laboratories and research facilities related to plant research at the University, such as the ARC Centre of Excellence in Plant Energy Biology, the Centre for Plant Genetics and Breeding and the School of Molecular Sciences," Mr Creasy says.

"That gives our researchers a seamless transition from plant growth environments to more intensive laboratory-based analysis, including everything from detailed chemical composition to molecular analysis."

With the first greenhouse in the precinct dating back to 1941, evolving technology has seen many changes over time.

"One of the trends is that the scale has changed – where we used to have 40 pots in a greenhouse, we now have 400 and we've adapted into an environment with specific and carefully controlled conditions for researchers to work in," Mr Creasy says.

"Scalability is important. In a place that's been around this long, we're constantly adapting.

"For example, we've introduced mobile benching systems that have provided us with wider walkways and the scale we need in modern science, allowing us to tease apart the questions that need answering."

A fertile growing environment

Producing science that is robust, reliable and reproduceable

The precinct has capacity for a wide range of research projects and is available to all staff and students, while also supporting national and international collaborative research to solve global challenges.

"Whether the students or researchers are from agricultural science, botany, plant biology or whichever discipline across the university, or industry, government or the community, our focus is on achieving successful outcomes," Mr Creasy says.

"UWA has great expertise 'below the ground', looking at what happens beneath the earth's surface. It's a lot harder to research because it's less visible, but there are more gaps in the science and so it's a really fertile space to explore.

"When you look through the windows, what looks like a simple plant in a glasshouse might be someone's future career. Ten years of hard work may have gone into getting that plant to exactly where it is right now.

"Biology doesn't always do what you want it to do and it's our job to try and limit the risk of adverse outcomes with science that is robust, reliable and reproduceable."

The overarching focus in 2023 is the pressing need for sustainable global food solutions.

The PGF has the capacity to perform experiments at elevated carbon dioxide concentrations to evaluate the impact of global climate change on biological systems.

"We're looking to adapt cropping to almost unimaginable challenges and a lot of the work we do is in the upstream space, providing great opportunities for students to be involved.

"I love what I do here – there's not many places you can work that are entirely about making ideas into reality. Undergraduates, postgraduates and researchers, all who have ideas that we then make happen," Mr Creasy says.

"Seeing the PhD students develop into research scientists, that moment when someone understands something and the light bulb goes off, it's amazing.

"It's not just my team but the whole University supporting what goes on and all of the workflows here. Everyone, from the cleaners to the repairs guys and the guys who drive the forklift, they're all important." ■

For more information contact:
pgf-plants@uwa.edu.au or **+61 8 6488 8549**

Senior Research Fellow Dr Judith Lichtenzveig, also from UWA's School of Agriculture and Environment, was born in Argentina but completed her higher education in Israel.

"I completed my undergrad in life sciences by the gorgeous Negev desert where I got interested in plants and their adaptation to seasonal changes," Dr Lichtenzveig says.

"I struggled with genetics so of course decided to do two postgrad degrees in the subject, with the first, my master's, on the compatibility of different species of climbing cacti.

"My PhD project was on the genetics and epidemiology of chickpea response to a detrimental fungal disease, *Ascochyta blight*.

"Currently, our team focuses on gene flow between annual species, gene introgressions from wild to cultivated crops, and the effects of temperature and light quality on plant responses against pathogens and on reproductive phenology.

"The Plant Growth Facility is like a little heaven for us – it serves such a large and diverse group of researchers, not only from academia but breeding companies and the Department of Primary Industries and all sorts of national and international organisations."

Senior Research Fellow Dr Judith Lichtenzveig

FEATURE

Best-practice farming systems research and real-world experience

AT UWA FARM RIDGEFIELD

By Rosanna Candler

Picture a scientist conducting research at The University of Western Australia. Are they tucked away in one of the many laboratories on the Crawley campus? Are they wearing a white coat?

Emeritus Professor Graeme Martin at UWA Farm Ridgefield

It's unlikely that the first location to come to mind is the rolling hills of Pingelly – a small country town in Western Australia's Wheatbelt, about 90 minutes' drive south-east of Perth.

You almost certainly didn't imagine knee-high gumboots slick with mud, a busted wide-brimmed hat and layers of thermals to stave off the chill.

And yet, this is the reality for many university researchers, students and collaborators who consider UWA Farm Ridgefield to be the epicentre of their agricultural and environmental studies and innovative research pursuits.

A 1600-hectare mixed-enterprise (sheep and cropping) farm in West Pingelly, UWA Farm Ridgefield is situated on Gnaala Karla Booja and under the spiritual and cultural custodianship of the Noongar people, whose connections to the land can be traced back more than 45,000 years.

At the farm, The UWA Institute of Agriculture manages and operates the Best Practice Farming Systems (BPFS) Project, which aims to find best-practice solutions for resilient dryland farming systems, environmental stewardship and community engagement.

Institute Director Hackett Professor Kadambot Siddique said the BPFS Project developed and supported multidisciplinary research that was economically viable, environmentally credible and created tangible social benefits.

"The pursuit of innovative and profitable dryland farming systems, progressive environmental stewardship and strong regional communities is central to all activities at UWA Farm Ridgefield," Professor Siddique said.

"It would be impossible for us to achieve these goals without harnessing valuable collaborations with numerous state and federal departments, fellow universities, research institutes and non-government agencies such as WA grower groups and other specialised agencies."

Someone who knows first-hand the value of UWA Farm Ridgefield from a research and teaching perspective is soil geomorphologist and Head of the UWA School of Agriculture and Environment, Associate Professor Matthias Leopold.

"UWA Farm Ridgefield captures millions of years of landscape development, preserving ancient laterite soil profiles and associated plants and animals next to areas influenced and shaped by modern agriculture," Professor Leopold said.

"Our society depends on agriculture for food and fibre production.

"The farm is an excellent area for environmental studies that target the human impact on natural systems."

A significant model for large-scale ecological restoration on the farm is the Ridgefield Multiple Ecosystem Services Experiment.

Established in 2010, this ongoing project provides a unique site to demonstrate how to provide multiple ecosystem outcomes for both farmers and the broader public, through restoration of agricultural land.

Professor Leopold said he fondly saw UWA Farm Ridgefield as an "outdoor classroom" where students could be exposed to case studies within a real operating farm.

"This is the most applied form of learning, as it provides understanding of agricultural and environmental systems beyond what they read in their textbooks," he said.

"Digging and analysing soil properties, studying annual water circles, understanding the challenges of managing mixed-enterprise agricultural systems under changing market and climatic conditions … this inspires our students and prepares them for their future.

"Not to mention, there is also an enormous mental, physical and social benefit for students on these field trips, which is an excellent way to foster UWA student experience."

Reproductive biologist Dr Kelsey Pool has a busy research schedule that frequently requires her to spend days and even weeks at UWA Farm Ridgefield.

As the current EHB Lefroy Fellow, Dr Pool aims to contribute to a better mechanistic understanding of reproductive biology in sheep while providing tangible outcomes to the Australian livestock industries.

"UWA Farm Ridgefield provides a rare opportunity to run intensive research in a true commercial farming system," she said.

"This is incredibly valuable, not only for capturing biologically relevant data in animal physiology, but also for understanding how this is impacted by regional climate and day-to-day operations that would normally occur on a commercial property."

Dr Pool said UWA Farm Ridgefield's manager and staff were very knowledgeable about the farm – both as a business and biological system.

"Their valuable feedback and advice to researchers streamlines our studies to better contribute to agricultural industries," she said.

"We can't replicate those conditions, or these people, on a city campus."

On the national and international stage, Dr Pool said UWA Farm Ridgefield gave UWA a "unique edge" as it boosted the adoption potential of its research.

UWA Farm Ridgefield
Image: Jarryd Gardner

"Demonstrating that research strategies can work in a commercial system to improve agricultural outcomes is a powerful thing," she said.

"There are not many institutions where you can effectively take science from the lab to the farm, which is the perfect workflow for agricultural research."

At any one time, there may be dozens of research projects under way at UWA Farm Ridgefield.

The big picture aim of these projects include mitigating on-farm greenhouse gas emissions, adaptations for the changing climate, enhancing profitable and ethical production systems, and restoring ecosystems and biodiversity.

Emerita Professor Lynette Abbott (first from left) with UWA student volunteers at the land restoration demonstration site

The UWA Farm Ridgefield 2023 Open Day on Friday 6 October presents a unique opportunity for all members of the public to attend in-field demonstrations and learn about the science from lead researchers.

Find out more and register to attend the UWA Farm Ridgefield 2023 Open Day at: **https://shorturl.at/nFSX2**

For more on Dr Kelsey Pool's research see pages 18–19.

Shift to non-mules enterprises

UWA Farm Ridgefield has helped blaze the trail to end the practice of mulesing sheep.

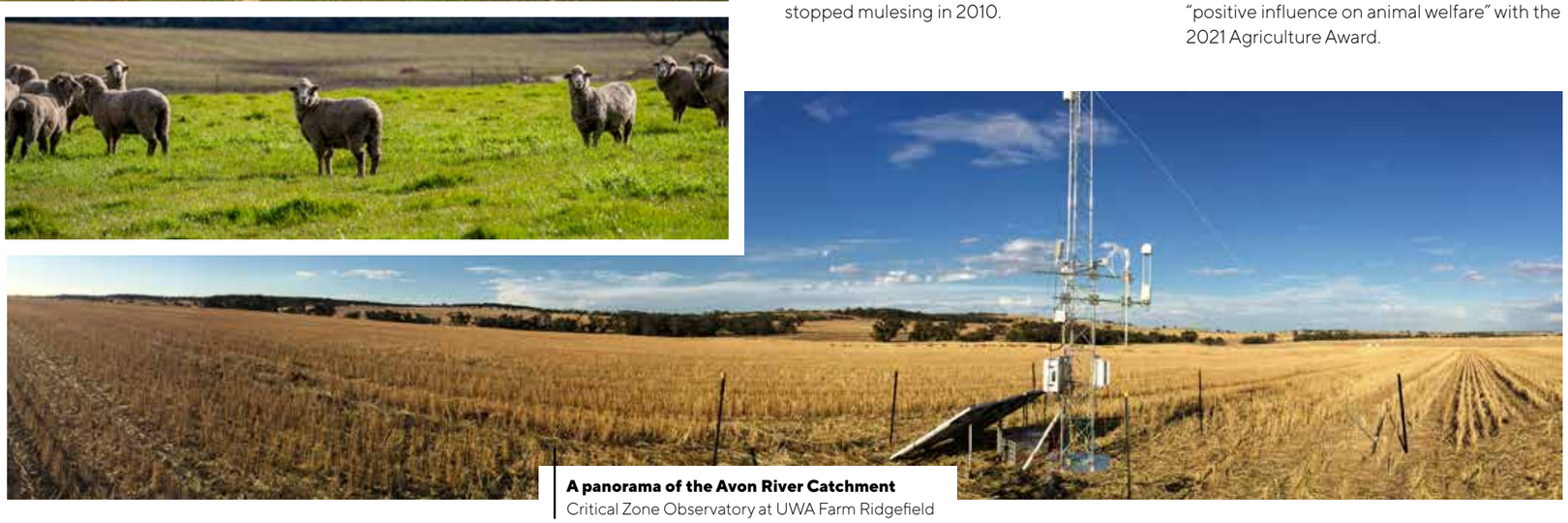
The Meat & Livestock Australia-funded joint project between UWA and AgPro Management demonstrated the impact of shifting to non-mules to both producers and the wider industry.

Recognising the inevitability of the technique being banned, Emeritus Professor Graeme Martin said UWA Farm Ridgefield stopped mulesing in 2010.

"It had long been clear that mulesing would end at some stage, with highly visible campaigns by animal rights groups that, justifiably, labelled it as unacceptable," Professor Martin said.

"We now have more than a decade's experience in managing non-mulesed Merino sheep."

RSPCA WA recognised the Non-Mulesing Producer Demonstration Site Project for its "positive influence on animal welfare" with the 2021 Agriculture Award.



A panorama of the Avon River Catchment
Critical Zone Observatory at UWA Farm Ridgefield

Breaking new ground with OZCZO tech

Earlier this year, a real-time soil sensing device, known as the Sensoil Vadose-zone Monitoring System, was installed in a cropped field at UWA Farm Ridgefield.

The VMS was the most recent of numerous sensing and monitoring infrastructure established at the farm, as supported by TERN and AuScope.

In 2013, UWA Farm Ridgefield became the first Australian node of the Critical Zone Observation (OZCZO) network, which explores below and above-ground connectivity between soil, sediment, water and plants.

"The cereal-pulse-oilseed-pasture rotations at UWA Farm Ridgefield capture a representative and responsible Australian agricultural practice," School of Engineering Associate Professor Sally Thompson said.

"We can also link into longer-term fundamental questions about landscape evolution and how the soils, water and ecology of the Western Australian grainbelt work together."

For more on Associate Professor Sally Thompson's research, see page 28.

Deep roots of research and experience

For world-renowned soil scientist Emerita Professor Lynette Abbott, UWA Farm Ridgefield is truly one of a kind.

"The farm provides a unique opportunity for me to conduct long-term carbon research on a commercial farm," she said.

Professor Abbott established the Land Restoration Demonstration Site with a grant from the National Landcare Program, which shows how upscaling novel soil restoration practices can re-establish productivity on degraded areas of farmland.

Professor Abbott said she was proud that UWA was fully committed to supporting ongoing research and development at UWA Farm Ridgefield.

"Over the years, I have especially enjoyed how our undergraduate and postgraduate students have risen to the challenges of learning on the farm," she said.

"Seeing how they proactively contribute to their own education, as well as build upon the farm base and connect with the local community, has been enormously rewarding." ■

HONEY TALKS

Multidisciplinary research into every aspect of honey production has uncovered rich potential for the nation's beekeeping industry.

By Carrie Cox

A five-year research program drawing on expertise from every corner of UWA is helping to harness the potential of Australian honey, historically one of the world's most undervalued sources.

The Cooperative Research Centre for Honey Bee Products grew out of a successful CRC grant application in 2017 by UWA research development advisor Liz Barbour. It soon expanded into a multidisciplinary team comprising researchers from areas as diverse as engineering, chemistry, geography, biology and business — a veritable hive of research activity.

According to Dr Barbour, who served as CEO of the centre until the CRC's official expiration in late 2022, the program soon tapped into a belief in the uniqueness of Australian honey and its untapped commercial and medicinal potential.

"Most of these researchers had never worked together before, but things came together very swiftly because everyone could see the value that could be added to this industry in so many ways," Dr Barbour says.

"Particularly here in WA, you're talking about some of the purest honey in the world, most of it from flowering forests and all of it free from agriculture chemicals – it's extremely rare.

But Australian honey across the board has been undervalued compared to honey from other countries and so one of the most important goals of the CRC was to produce outcomes for the industry that would help drive up the price of honey."

Developing honey 'fingerprints'

One of the many tangible outcomes of the CRC was the development of a 'fingerprinting' system to identify honey varieties, which is critical to enabling robust authentication of honeys, supporting quality control efforts and providing a baseline dataset for other research.

Associate Professor Cornelia Locher headed up this area of research, which ultimately resulted in the fingerprinting of 450 Australian honey samples, many now being registered internationally.

"We looked at the non-sugar components of honey and we zoomed right into them because they are chemically often related to the nectar source, which has a specific signature," she says. "We used a technique known as High Performance Thin Layer Chromatography to separate the non-sugar constituents of honey.

"The beauty of this technique is that it's quite visual and we produced fingerprints that present as bands of colour, which is not only helpful from an authentication point of view but also a marketing tool."

> ‘Particularly here in WA, you're talking about some of the purest honey in the world, most of it from flowering forests and all of it free from agriculture chemicals – it's extremely rare.’

Indeed, the marketing arm of the CRC – led by UWA Business School researcher Professor Sharon Purchase – used these coloured fingerprints as key components of the branding strategy they devised for WA honey varieties. Honey jar labels were produced with batch numbers and a QR code that takes consumers to a website with all the key information about the honey's origins, including its specific fingerprint.

Associate Professor Locher says

Dr Liz Barbour, CEO of the Cooperative Research Centre for Honey Bee Products

besides capturing the diversity of honey varieties on offer within WA, producing chemical and antioxidant baselines highlighted those that are currently "flying under the radar" and could be better promoted or utilised. For example, a WA-produced variety called Red Bell honey exhibits extremely high antioxidant activity on a par with, or possibly even higher than, the famed Manuka honey.

"Now, with this baseline data and evidence of antioxidant activity, we can give information back to industry that is helpful for their marketing," Associate Professor Locher says.

"It's a great outcome and the industry is excited about it."

Assessing honey's antibacterial activity

Working closely with the chemistry team was Dr Katherine Hammer, from UWA's School of Biomedical Sciences. Her team carried out testing of the antibacterial activity of honey varieties, assessing their activity on different bacterial species.

"Traditional methods of testing didn't suit WA honey varieties, so we came up with our own new method that gives each honey what we call an Antimicrobial Activity Value," Dr Hammer explains. "In conjunction with the fingerprinting process, this enabled us to give the industry lots more robust data about their honey varieties."

One of Dr Hammer's CRC sub-projects tested the activity of a small selection of honeys against bacteria that produces 'school sores' or impetigo.

"The results were positive and indicated that the pathogenic bacteria are indeed susceptible to honey," she says. "The next stage of investigation would be to conduct clinical studies with patients to see if honey works in a real-world situation."

Diagnosing bee health

The CRC not only looked at the health characteristics of honey but necessarily of bees too. Biochemist and geneticist Dr Julia Grassl, from UWA's School of Molecular Sciences, led this area of research, which looked at disease detection in bees, breeding traits and nutrition.

"It's particularly important given today's climate conditions where accessible land is increasingly spare due to climate change, bushfires and urbanisation," Dr Grassl says.

One of her CRC projects targeted the bacterial disease called American foulbrood. "It's one of the most devastating diseases in the honey bee industry and really hard for beekeepers to detect," she says. "You're basically looking for one or two slightly indented cells within a whole hive, so it's easily overlooked.

"Its name comes from the fact that it smells, like death in fact, and as biochemists we know all smells are molecules; particles in the air. So what we did was capture the smell in an infected hive and then we identified the molecules that are specific to American foulbrood. So we now have a list of biomarkers that we know come from this disease and the next step is trying to make sensors for these molecules that will enable beekeepers to identify American foulbrood much earlier."

> A WA-produced variety called Red Bell honey exhibits extremely high antioxidant activity on a par with, or possibly even higher than, the famed Manuka honey.

Dr Katherine Hammer and PhD student Kathryn Green carried out testing of the antibacterial activity of honey varieties. Image credit: Ian & Erick

Harnessing honey's market potential

Working closely with the scientists on the honey bee CRC were marketing experts from UWA's School of Business led by Professor Sharon Purchase. Driven by the industry's imperative to increase the price of Australian honey, Professor Purchase's team quickly established that the greatest sales potential existed in the export market.

"We did market research to look at the buying narratives specific to particular countries and regions, the most common being 'terroir', which includes product information about geography, environment, heritage, soil and flowers, and how all of this comes together," she says. "Terroir is particularly important to honey buyers in the Middle East, whereas the health narrative is important in China and the taste narrative is important in the UK."

The marketing team was also instrumental in the development of a 'chain of custody' for honey bee products, the major component of which was the digitisation of the industry's existing paper-based quality assurance system known as B-QUAL.

A hive of research activity

Other CRC projects have produced B-AGENT, a spatial modelling framework to help migratory beekeepers understand the effects of pressures like climate change on their beekeeping environments, and B-spatial, a decision support tool to help beekeepers select suitable apiary sites.

Besides the many legacy outcomes of the CRC, a number of research projects have continued beyond the CRC's 2022 end date, a reflection in no small part of the enthusiasm of the researchers involved.

"Yes, we've all got the honey bug now," says Associate Professor Cornelia Locher. "There's ongoing research into clover honeys and the use of honey in wound care. We're also now working with the University of Athens because they want to fingerprint some European honeys.

"There's also a native bee honey project that's ongoing. And there's our spinoff commercial venture, Y-Trace, a honey testing lab in Yanchep that provides our techniques as affordable commercial services for beekeepers. We're definitely still buzzing." ■

SUSTAINABLE FARMING

The race against time

By Carrie Cox

The chaotic impacts of climate change on livestock systems have brought an increasing sense of urgency to research projects within UWA's School of Agriculture and Environment.

Dr Kelsey Pool and producer Lachlan Watts check a lambing mob of twin-bearing ewes

The mounting impacts of heat stress on animals, water availability and unseasonal weather patterns are increasingly disrupting livestock production systems grounded in routine and predictability. In a sector that contributes 40 per cent of the global value of agricultural output, producers are now turning to science for the answers to securing a sustainable future.

Working closely with the State's agricultural producers, peak bodies and government, UWA researchers are driving a raft of major projects designed to improve agricultural yields, mitigate the effects of climate change and achieve sustainable practice while preserving animal welfare.

Lefroy Research Fellow Dr Kelsey Pool is applying reproductive biology to a range of projects designed to improve the fertility of livestock.

"If you've got sub-fertile animals or your reproductive reach isn't where it should be, you're pouring a lot of resources into animals and not getting a return on that time and investment," Dr Pool says. "Reproductive efficiency is the key baseline for sustainability."

Dr Pool's research includes looking at the impacts of heat stress and oestrogenic clover (a pasture species commonly used in agriculture but linked to issues in ewe reproduction) on breeding cycles. "We're looking at how heat stress changes the way animals reproduce and also how they behave during breeding seasons: how long do the effects last, are they chronic, and do they accumulate over time?" she says. "In terms of oestrogenic clover, we know that oestrogenic compounds can disrupt endocrine systems, so as these hostile things build up in the environment, you're seeing it start to impact production."

Above: Honours student Callum Connolly, Dr Luoyang Ding and Dr Kelsey Pool at UWA's Ridgefield Farm
Left: Researchers check reproductive outcomes in twin-bearing ewes treated with melatonin during pregnancy

Dr Pool is also carrying out research to help mitigate the unusually high mortality rate of twin-bearing ewes. "This is quite a serious issue for the industry, not just in terms of production but also from an animal welfare perspective," she explains.

"We've shown that melatonin implants can have a positive effect in terms of changing the foetal vascular communication between mother and bub before they're even born. We're targeting the early gestation phase to change the animals' development and then also late gestation where we're targeting the birth process."

Animal welfare underpins all research carried out by the School of Agriculture and Environment and driving its principles is Associate Professor Dominique Blache.

A neuroscientist by profession, Associate Professor Blache believes that the happiness and wellbeing of livestock animals is not so different to — and certainly no less important than — that of humans. He says having tangible measures of animal welfare is critical to producing meaningful research.

"Without measurements, you can't act, so we're working on ways to tangibly measure markers of welfare — those responses to stressors that can be either physiological or behavioural," Associate Professor Blache says. "For example, we're in the second year of a three-year project involving sheep and the measurable benefits of giving them greater access to shade and shelter. With the help of producers right across the state and using the animals on our own UWA farm, we're using GPS collars and temperature loggers to track animals every five minutes during the mating and lambing seasons."

> 'We're looking at how heat stress changes the way animals reproduce and also how they behave during breeding seasons.'

Associate Professor Blache says the backing of industry is vital to his team's work.

"One of the biggest changes in the past 20 years is the involvement of the agricultural industry right from the stage of funding applications for research," he said. "They love research and they want to be involved, not just for the sake of their production but for the wellbeing of their animals and because they're now much more conscious about the environment – they know the land is fragile." ■

GRAPE *expectations*

By Doug MacLaurin

Associate Professor Michael Considine

UWA researchers are on a mission to grow export and agriculture opportunities, improve health outcomes and ease global hidden hunger through diversifying and revitalising underutilised functional foods.

One project is targeting the nation's largest fresh fruit commodity: table grapes are worth $620 million in exports, but Australia imports $80 million of the produce to cover the seasonal production gap.

Associate Professor Michael Considine, from The UWA Institute of Agriculture (IOA) and WA Department of Primary Industries and Regional Development, is looking north to shrink that gap — and introduce more diversity to the region's farming systems.

But establishing grape crops in the Kimberley isn't simple.

"Most of our fruit production is in the south-eastern quarter of Australia — you can't just shift table grapes into a different climate and expect them to behave the same way," Professor Considine said.

"To me that's a fascinating challenge. I love the idea of extending that production window by understanding the relationship between plants and their environment and using new practices that might trick them to think they're in a different climate."

It's just one of many crops ripe for growth. In 2001 Australia exported more than 35,000 tonnes of apples, but exports dropped below 5,000 tonnes by 2021.

"Now our domestic market almost doesn't register on the global scale of exports. New Zealand in fact exports a lot more apples than we do," Professor Considine said.

"We should look to learn from New Zealand in the innovation and the nutrition focus that they've had because they've worked hard to create economic opportunities and negotiate trade agreements."

While packaged snack foods have stolen market share from fresh fruits, Professor Trevor Mori from the UWA Medical School and IOA says developing an appetite for functional foods again will improve the health of more than just the economy.

"We're trying to enhance current foods with enriched nutrients that we know modify cardiovascular risk factors, which has the flow-on effect of reducing cardiovascular disease," Professor Mori said.

> I love the idea of extending that production window by understanding the relationship between plants and their environment.

"The current focus is moving away from looking at specific nutrients in isolation to whole foods, especially plant-derived foods."

But society's fast-food addiction is a hard habit to break.

"We've been pushed in the other direction of the so-called ultra-processed foods, which are so far removed from their original form and devoid of nutrients you couldn't even really call them a food."

The poor dietary diversity is losing some of the gains made in heart health.

"Cardiovascular disease has actually come down since the 1960s — what we're seeing at the moment is a slight rebound up," said Professor Mori.

"The burden on the health system is enormous — there's one heart attack death per 12 minutes in Australia per day. More than 60 per cent of adults are overweight or obese. That's frightening because of the direct link with diabetes. If we continue down this pathway, it's only going to get worse."

Director of The UWA Institute of Agriculture, Hackett Professor Kadambot Siddique, says neglected or underutilised plants/crops also hold the key to tackling malnutrition globally.

In the Asia Pacific region alone, it's estimated more than 350 million people are undernourished — about half the global total.

The problem is rooted in food systems that rely on a few staple crops, especially rice, maize and wheat, while overlooking other nutrient-rich grain, legume and vegetable options in the region.

"We are talking about close to a billion people suffering malnutrition and hidden hunger globally because of the lack of a dietary intake of those things," Professor Siddique said.

"We have to diversify. It's a matter of convincing governments there's lasting value in those commodities — and the proof is there in crops like quinoa, which has achieved commercial importance globally."

Once struggling farmers in Bolivia now earn substantial revenue from quinoa, while Peru saw its quinoa exports grow almost tenfold over a five-year period to become one of the world's leading producers.

Professor Siddique says it's just one of many examples.

"Pulse production — which includes lentils, chickpeas, faba beans, peas and common beans — has increased in many countries," he said.

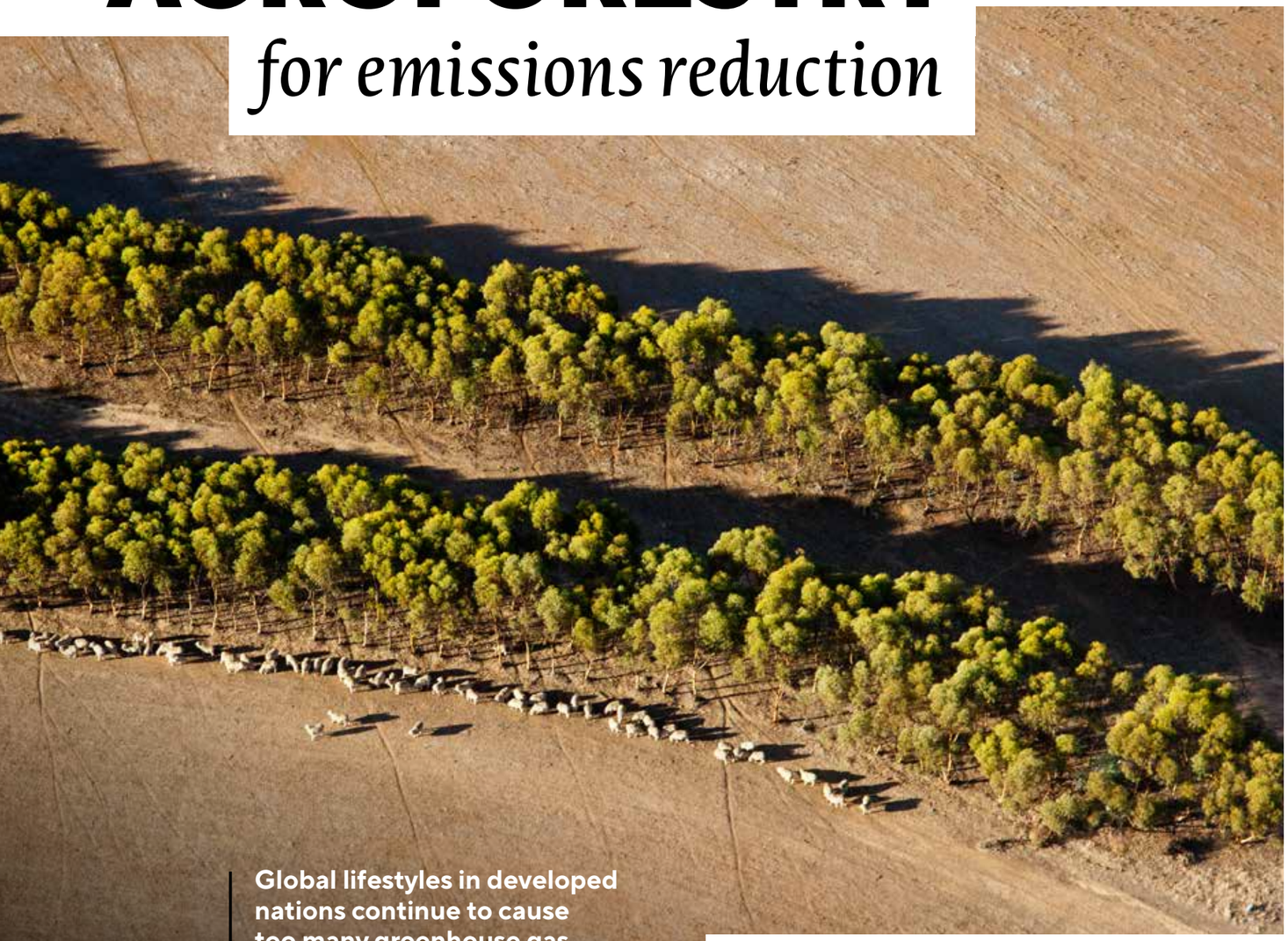
"Provided we can show solid evidence to policymakers to take on this diversification, the market will emerge". ■

Top: Hackett Professor Kadambot Siddique
Below: Professor Trevor Mori

Quinoa crops

By Professor Ross Kingwell

AGROFORESTRY
for emissions reduction



Global lifestyles in developed nations continue to cause too many greenhouse gas emissions. Removing some of these emissions is one required remedy. Most of us already know one example of a natural remedy — trees.

Professor Ross Kingwell teaches in the UWA School of Agriculture and Environment. He is also chief economist with the Australian Export Grains Innovation Centre and the Department of Primary Industries and Regional Development. His research focuses on grain supply chain analyses, strategic market opportunities for Australian grains, farming systems analysis, and agricultural emissions management.

Trees extract carbon dioxide from the atmosphere and store it for decades, even centuries, in their limbs and roots. So this option to reduce emissions is tantalisingly simple to implement. Just plant more trees!

Although that advice is appealing, responding to its apparent wisdom is not without difficulty as many questions subsequently arise such as: where should these trees be planted? How many need to be planted? Are there only environmental benefits from planting trees or are there also economic costs and benefits?

There may be no single answer to such questions, which is perhaps illustrative of why the social and political debate surrounding emissions management is at times fierce, even polarised.

The role of trees in agricultural regions

My research experience is in agriculture in Western Australia, so I will confine my comments to the role and value of trees in this State's agricultural region in emissions management.

Firstly, emissions from agriculture in Western Australia have been mostly stable since 2012 at just under 10,000Gg carbon dioxide annually. These emissions form 10 per cent of the State's emissions but are dwarfed by the energy sector that generates 83 per cent of the State's emissions. Planting trees in agricultural regions is one option for farmers to offset or abate their own industry's emissions.

Secondly, what is often underappreciated is that many farmers have already committed parts of their farmland to revegetation and agroforestry. These activities biologically fix or sequester carbon dioxide, thereby helping reduce net emissions. The magnitude of this sequestration is such that, for example, in 2020 nearly all (97.5 per cent) emissions from agricultural activities in Western Australia were balanced by carbon sequestration activities on land managed or owned by agricultural businesses. So, carbon neutrality for the State's agricultural sector appears within reach.

Whether planting more trees is the most cost-effective way of finally achieving carbon neutrality for agriculture or any other sector is an interesting question. In my view there are better, longer-lasting technological solutions that, at source, prevent or reduce emissions rather than offset those emissions.

Professor Ross Kingwell

Planting trees to be permanent stores of sequestered carbon overlooks their exposure to bushfires that can undo decades of sequestration.

Thirdly, the emerging challenge for agriculture in this State likely comes not from farmers switching farmland into tree plantations to deliver carbon neutrality for agriculture. Rather, the challenge likely comes from sectors outside agriculture that seek to buy and convert farmland into forestry plantations to offset their own sectoral emissions. Such changes in land use have many economic and social ramifications.

> ‘Whether planting more trees is the most cost-effective way of finally achieving carbon neutrality for agriculture or any other sector is an interesting question.’

Planting trees is far less labour-intensive than ongoing agricultural activity and generates far fewer value-adding or industry multiplier opportunities. Regional economies are far more likely to be less economically and socially vibrant when large swathes of farmland are converted into permanent forests. Also, switching land away from food and fibre production reduces the State's potential agricultural export income.

Lastly, the harsh reality for tree plantations is that trees eventually mature and no longer continue to store inexorably increasing amounts of carbon, making tree planting a likely second-best option. Yes, trees, in the absence of bushfires, provide sequestration for a handful of decades, but the first-best option is to efficiently reduce emissions at source. That solution requires technological and policy innovation.

So, maybe more trees in agricultural regions for emissions abatement is actually not unambiguously preferable. That said, trees do perform other useful roles in providing shade, habitat, visual amenity, increased biodiversity and some tree species can be sources of renewable fuel. ■

Next generation of agricultural research on show

By Rosanna Candler

Delivering the opening address at The UWA Institute of Agriculture's 17th annual Postgraduate Showcase was the perfect full-circle moment for Department of Primary Industries and Regional Development (DPIRD) Chief Scientist Dr Ben Biddulph.

As the Institute Director Hackett Professor Kadambot Siddique recognised in his introductory speech, Dr Biddulph attended the event 15 years earlier – not as an audience member – but as a student presenter.

"I am sure you have fond memories of standing up here for our inaugural Postgraduate Showcase in 2007," Professor Siddique said.

"As you know, this event is an invaluable opportunity for our chosen postgraduate students to engage with and enlighten farmers, fellow scientists, academics and the wider agricultural community."

To date, 129 early-career researchers have presented their achievements in agriculture and related areas at the annual Postgraduate Showcase.

In addition to Dr Biddulph, notable former presenters include UWA Centre for Agricultural Economics and Development Deputy Director Dr Fiona Dempster, West Midlands Group executive officer Dr Nathan Craig and InterGrain Business and Research Development Manager Dr Dini Ganesalingam.

Hackett Professor Kadambot Siddique presenting at the showcase

L–R: Mukesh Choudhary, Samalka Wijeweera, Junrey Amas, Sylvester A Obeng-Darko, Bablu Hira Mandal, Professor Kadambot Siddique, Marcela Del Carmen Vieira, Emeritus Professor Graeme Martin, Dr Ben Biddulph, Professor Sharon Purchase and Doraid Alkhishaybi

> This showcase is an invaluable opportunity for our chosen postgraduate students to engage with and enlighten farmers, fellow scientists, academics and the wider agricultural community.

Dr Biddulph said he was enthusiastic about hearing from the next generation of agricultural researchers.

"It is critical for our sector to engage better with universities and the academic systems to make sure we are working on solving industry problems and challenges going forward," he said.

"Through the WA Agricultural Research Collaboration, we have $25 million from the State Treasury over the next three years to build that mid-career capability at a postdoc and PhD level."

About 100 people attended the 2023 Postgraduate Showcase: Frontiers in Agriculture at UWA's Bayliss Lecture Theatre on May 31.

Seven outstanding postgraduate students from across three schools were hand-picked by the Institute to present their research achievements in agriculture and related areas, and each was coached by Emeritus Professor Graeme Martin.

The two sessions were chaired by the Head of UWA School of Agriculture and Environment, Associate Professor Matthias Leopold, and UWA Business School Professor Sharon Purchase.

The innovative topics included Marcela Del Carmen Vieira tracing the economic impact of dung beetles in Australia, Junrey Amas identifying disease resistance in canola, Mukesh Choudhary and Samalka Wijeweera investigating how to enhance heat stress and salt (respectively) tolerance in wheat, and Sylvester Obeng-Darko finding factors that influence dihydroxyacetone in honey.

PhD candidate Bablu Hira Mandal, who explored the role of fulvic acid in alleviating glyphosate damage to crops, said his Postgraduate Showcase experience was both "exciting and inspiring".

"I was thankful to meet new people and discuss current and future research and possible employment opportunities," Mr Mandal said.

"Specifically, I have learned how to convey scientific findings to the non-scientific community in a simple but understandable way, which will help me to boost my professional goals in the future."

Animal scientist Doraid Alkhishaybi said he was grateful for the opportunity to share his research findings on the effect of heat stress on sperm quality in Merino rams.

"I really valued the chance to meet other PhD candidates and hear about their multidisciplinary and cutting-edge research," Mr Alkhishaybi said.

"The showcase also allowed me to present my research to a diverse audience, ranging from farmers to scientists, non-profit organisations and government agencies.

"It was an opportunity to integrate, meet new people, discuss current research and explore future employment opportunities." ■

SUSTAINING THE *next generation* OF FARMERS

Fourth-generation farmer and agricultural consultant Georgia Pugh has a passion for innovation and technology which improves efficiency, sustainability and profitability in the livestock industry.

By Annelies Gartner

Although not a fulltime farmer, Mrs Pugh maintains an active interest in the family's 4000ha property in Narrikup, a small town between Albany and Mount Barker in the Great Southern region of Western Australia.

On the mixed cropping and livestock farm, the family runs 12,000 sheep and 1,200 cattle and breed purebred Gelbvieh and Gelbvieh composite cattle — Summit Gelbvieh Stud.

"We're a family farming contingent led by my father John and mum Kim and we've had women farming for generations in our family," Mrs Pugh says.

"It is a love of nature, a love of animals and being able to give back and care for the land. We have a lot of sheep and cattle, which we really care about and do our very best to run well."

Mrs Georgia Pugh

Mrs Pugh graduated from The University of Western Australia in 2015 with a double degree in Agricultural Science (with First Class Honours) and Commerce majoring in accounting, entrepreneurship and innovation.

She now works for neXtgen Agri International and has been driving the adoption of agricultural technology in Western Australia, including on the family farm.

Mrs Pugh specialises in providing strategic business and livestock breeding advice, as well as agricultural technology adoption support to optimise farm performance and operational efficiency.

"Farmers have always been investing in genetics and we can help them accelerate their genetic gain, but technology is something that livestock farmers in particular have found more daunting to adopt," she explains.

The youngest of four girls, who is now a mother of two, says the average age in the livestock industry is 52—12 years older than the national average for other occupations, and, while historically it's not been a super tech-savvy industry, that is changing which is encouraging to the next generation of farmers.

"If I show my kids some of the apps available, they think they're so cool and it makes them more likely to want to get involved in agriculture," she says.

The new technology has helped make record-keeping, information-sharing and decision-making a lot easier for livestock producers.

"On the family farm we had a whiteboard in the workshop with numbers written on it," she says.

"Now you can use an app that gathers information from smart collars, smart tags and drones that tell you how many animals are in a particular paddock, how many days they have been in there and when they are due for a shift.

"Sensor cameras on water troughs and in paddocks can tell you how much rain there has been so you can calculate how much pasture you're going to have and the food that will be on offer."

Career options in the industry are growing as new technology continues to be developed, but Mrs Pugh says there are still many lessons to be learnt.

"A lot of the agtech is coming from start-ups and aren't earning much money yet,' she explains.

"They want the feedback to understand what they can do to help — having the feedback from the farming community, good or bad, is invaluable."

Mrs Pugh always knew the career path she wanted to take and believes mixing good business practice with the analytical scientific aspects of agriculture has helped her excel in her chosen industry.

"I always had a strong agricultural muscle being a country girl and actively involved in the industry, but I've worked on building my business muscle a lot," she says.

"I want to make everyone's life easier and as a result make farming more sustainable and efficient." ■

Water WISE

By Carrie Cox

Nature-lover Sally Thompson has devoted an esteemed engineering career to the changing role of water in human and natural systems.

Associate Professor Sally Thompson

The passion that continues to shape Associate Professor Sally Thompson's career in environmental engineering was seeded at a tender age. Enchanted by Gerald Durrell's much-loved children's book *The Fantastic Flying Journey*, as a seven-year-old she became both a lover of the natural world and someone with a prescient sense of the forces that threaten it.

"Even as a little tacker, I was worried about environmental problems," Associate Professor Thompson recalls, "because you could see them, you know. If you went for a drive in the Wheatbelt in the 80s, you couldn't escape the salt lakes. You could see the salinisation. I became more and more aware that much of what I could see — the environmental threats that were beginning to mount — were a product of misplaced land management and that many of the potential solutions were about engineering in the landscape."

Armed with an undergraduate degree from UWA, Associate Professor Thompson soon found herself swept away from her beloved home state, completing a PhD at Duke University in the US and then working as a postdoctoral scholar at Princeton and Purdue universities. From there she was appointed Assistant Professor of Surface Hydrology at the University of California Berkeley, ultimately promoted to Associate Professor with tenure in 2017. While her years abroad delivered many unique research experiences — from studying wave modelling in Lombok to hunting for missing rivers in India — Associate Professor Thompson jumped at the opportunity to return to UWA in 2019.

"One of the really positive things for me about coming back to WA is that from a research perspective, we do have these very close ties with industry and with government who are a joy to work with," Associate Professor Thompson says. "They tend to be focused, forward-looking people who genuinely listen."

One of the projects her research team is currently working on with the WA Department of Water and Environmental Regulation involves monitoring groundwater recharge — the replenishment of the water table from rainfall. "Here in the city we get about 40 per cent of our drinking water from our groundwater. Groundwater also supplies most irrigation water for market gardens and Perth backyards. It keeps our wetlands wet and is also used by industry.

"While there has been a lot of monitoring of groundwater levels, we haven't done much monitoring of what recharge is doing: how it's changing between wet years and dry years or between places with deeper or shallower groundwater levels. The big question is what will recharge do in a changing climate, because we are going to be increasingly dependent upon groundwater as the climate dries."

> ‹ Groundwater also supplies most irrigation water for market gardens and Perth backyards, it keeps our wetlands wet and is also used by industry. ›

In the agricultural research space, Associate Professor Thompson's research team has been working at UWA Farm Ridgefield to install a 'Critical Zone Observatory'. It's a blue-sky project that aims to track and measure the complete vertical journey of water from sky through the soil — pulling together all the processes and elements that are traditionally studied in isolation by different areas of expertise. It's a national project led by Associate Professor Thompson, with four other sites being developed in South Australia, New South Wales and Queensland.

Her team is also working with Associate Professor Nik Callow, from UWA's School of Agriculture and Environment, on a project called 'Smart Dams'. A response to the fact that dams are becoming increasingly less effective in insulating WA farmers from water shortages, Smart Dams is exploring technological and geological solutions to evaporation suppression and to enhancing the amount of run-off that can enter dams.

Associate Professor Thompson says: "Smart Dams is working with four regional grower groups in a genuine partnership — university researchers working closely with people on the ground." ■

Can plants be genetically programmed to save themselves?

Adil Khan has not seen *The Martian*. But his work is helping to ensure that when human beings do reach Mars, they will have a better time of it than Matt Damon's Mark Watney.

Dr Khan is a research associate in the ARC Centre of Excellence in Plants for Space and the Centre for Plant Energy Biology in UWA's School of Molecular Sciences. He is also a member of the International Space Centre's Plants for Space Node.

Among the challenges his work confronts is the capacity of earthly visitors to other planets to survive on food they can produce for themselves. If we can achieve that, settlement is a possibility. Our nearest and best prospect is indeed Mars.

Dr Khan came from a farming family in a small village in north-western Pakistan. The University of Agriculture Peshawar, about 40km away, changed his life. His imagination was fired and the range of his life possibilities enlarged by scholars who were encouraging and enthusiastic.

He learnt that a university could change your life, and that scientists could do "something for humanity". The daily commute between his village and the university brought together the worlds of theoretical exploration and practical application, each making sense of the other and broadening his understanding.

It was in Peshawar that Dr Khan was introduced to the fascinating possibility of engineering plants. To many that might seem a dangerous, even daunting prospect. Could we? Should we? Regardless, human beings have been "interfering" with plants for a long time: making them more useful to us, or simply more decorative.

Perhaps, Dr Khan reasoned, since we can make plants prettier and tastier, we can do even more. Perhaps we can make them more adaptable; able to survive and thrive without fertilisers and pesticides in the difficult environments wrought by drought, pestilence and salinity.

In search of the facilities that would enable him to do more advanced work, Dr Khan set his sights on a cricket-mad land like Pakistan: Australia. In 2012 he began a master's degree at the Australian National University, then completed his PhD at UWA under the supervision of Professor Ryan Lister, with whom he now works as a postdoctoral fellow.

Dr Khan's doctorate was focused on inventing gene circuits (based on DNA) that he connects to our understanding of electrical circuits. Rather than making a permanent alteration to the activity of a gene, his research asked whether a plant could be deliberately programmed to "switch on" a gene that confers resistance to certain pathologies or conditions — for example, when flies attack, or the heat is high, or water is in short supply.

Dr Adil Khan, whose focus is on inventing gene circuits in plants

Further, can genetic programs be written that ensure particular genes are "on" only precisely when and where they are needed? The answer was yes. The gene circuits Dr Khan and his colleagues developed achieved successful implementation with the model plant Arabidopsis.

The next step is to move them to useful applications in crops. It hasn't been an easy process to create this new technology from scratch. Dr Khan said there were inevitable frustrations when something that should have worked simply did not. "You have to be creative in your thinking," he said. "You need to go beyond the box." ■

Convocation Day 2023: Warden Jenny Gregory AM and Guild President Geemal Jayawickrama planting a tree

(left) 1948 photograph: Faith Clayton and John Short
(right) 2023 photograph: Madelaine Page and Felix Malcolm

From the Warden of Convocation

Convocation has been planting trees on our Crawley campus for a decade. It's a joint initiative between the Convocation of Graduates and the Guild of Undergraduates, sparked by UWA's Centenary in 2013. Since then, each Warden and each Guild President has had the honour of planting a tree with golden shovels no less. A special feature of each year's Convocation Day, it commemorates the first meeting of UWA's Convocation on 4 March 1913.

Why do we celebrate Convocation Day? UWA's founding Act of 1911 was passed as a result of lobbying by graduates living in Western Australia who called for a university. Under the Act, all UWA graduates are legally lifelong members of the University.

UWA was the inheritor of a model of governance stemming from the ancient British universities. In this model, a university recognises the value of its graduates and provides them with rights: to nominate and vote in elections for the Senate and Council of Convocation, attend general meetings of the University, review any proposed changes to the University's statutes, be consulted by the University administration on its future strategy, and discuss and express an opinion on any matter relating to the interests of the University.

Following that first meeting of Convocation in 1913, the interim Government-appointed Senate was dissolved. Convocation then elected 12 of its members, and the Governor appointed six members, to form an 18-person Senate. It was only then that the first students could be enrolled on 26 March 1913 and attend their first lectures just a few days later. Students then got together for the first meeting of the Guild of Undergraduates on 11 April 1913.

Without that first meeting of Convocation, UWA could not have begun operations; teaching its students as the only free university in the nation. A fact worth celebrating!

Often, we pair the Convocation Day tree planting with a special event and, as always, a sundowner. This year, we celebrated the 75th anniversary of the first play performed in the Sunken Garden in 1948 — Sophocles' *Oedipus Rex*. We began with a fascinating address by Dr Lara O'Sullivan from UWA's Classics and Ancient History that contextualised the play for the audience. Then two gifted young actors, Felix Malcolm and Madelaine Page, directed by Grant Malcolm from the Graduate Dramatic Society, gave us an engrossing re-enactment of a pivotal section of the play.

The 1948 performance is forever linked to the presence of superstars Sir Laurence Olivier and Vivien Leigh, in Perth on an Australian tour. Although Basil Balme (later UWA Professor of Geology), and Bill Heseltine (later Sir William and Secretary to Queen Elizabeth II) were unable to attend our re-enactment, we were thrilled to welcome the Reverend Douglas Brown, one of three surviving members of the original cast. ■

Historical images courtesy of UWA Archives

In the beautiful Walpole Wilderness area of Western Australia's South West is a remarkable ecosystem at the centre of an ambitious research project.

Researching the HIDDEN TREASURE OF THE SOUTH WEST

By Siobhon Eacott

Associate Professor Nicki Mitchell (centre) with Louise Arkles (IPF) and David Edmonds (WNNPA) Image: Holly Winkle

Associate Professor Nicki Mitchell, from The University of Western Australia's School of Biological Sciences, and co-lead of the five-year project *PEAT – Protecting Peatland Ecosystems and Addressing Threats in Southwestern Australia,* is hoping to uncover the secrets of this unique form of peatland, as well as how to protect it.

"Peatlands are a unique ecosystem, taking many thousands of years to form and housing some of our most ancient plant and animal species – yet we know relatively little about them," Associate Professor Mitchell said.

The project, co-led by UWA and Edith Cowan University, and guided by Elders, is a collaboration between academic and community-based scientists, managers, and volunteers, including the Undalup Association, the Department of Biodiversity, Conversation and Attractions, the Western Australian Museum and the Walpole-Nornalup National Park Association.

In Western Australia's South West, an internationally recognised biodiversity hotspot, peatlands are particularly diverse and contain stunning species such as the Sunset Frog and the one-of-a-kind Albany pitcher plant.

They also store vast amounts of carbon in their organic soils that may be several metres deep.

Despite their importance, these rare, waterlogged ecosystems face an uncertain future.

Pitcher plant. Image: Holly Winkle

Sunset Frog. Image: Nicki Mitchell

"The effects of climate change, particularly declining rainfall, have intensified wildfires across the country, which is leading to an overall degradation of peatlands if they are dry enough to combust," Associate Professor Mitchell said.

"The location of many peatlands is also still generally a mystery – they're understudied thanks to their remoteness and the fact their locations are difficult to map."

The community at Walpole and surrounding areas have become on-the-ground members of the data-collection team, and have organised 'BioBlitzes' that helped kick off the project.

Guided by Pibulmun Traditional Custodians and the Walpole-Nornalup National Park Association, these intensive biological surveys aim to identify and record as many species as possible in peatlands and surrounding areas in a short period. New species, particularly invertebrates, have already been discovered, and this kind of 'citizen science' will continue as part of the PEAT project.

"We're first focused on mapping the peatlands and finding our feet, as we begin to assess the reality of how fragile these ecosystems are," Associate Professor Mitchell said. "The community and DBCA managers are integral to the project's success, providing on-ground support and local knowledge."

The project has received $1.34 million funding from The Ian Potter Foundation, one of Australia's major philanthropic organisations, enabling extensive research on the geodiversity, biodiversity and hydrology of peatlands, informed by traditional knowledge and histories of landscape management by Traditional Custodians.

Knowledge generated from the project will be used to design management strategies to conserve peatlands in collaboration with government, traditional owners and the wider community.

"PEAT is an excellent example of how Western and Indigenous science can work hand-in-hand with communities to achieve positive outcomes for conservation," Associate Professor Mitchell said. "We hope that our collaboration will not only benefit peatlands in Western Australia but will provide insight and support for the protection of peatland ecosystems worldwide." ■

ON COUNTRY

BURNING
to protect our biodiversity

Aunty Carol Pettersen

A cross-cultural collaborative project is helping protect the unique biodiversity and cultural assets of the Great Southern region of Western Australia.

By Annelies Gartner

The *Walking Together Project* at UWA's Albany Campus combines Noongar knowledge with Western science to assist conservation.

In 2020-21, the project supported PhD candidate Ursula Rodrigues — recipient of the RSWA John Glover Research Grant — to research cross-cultural bushfire mitigation strategies, along with fellow researchers Professor Steve Hopper and Dr Alison Lullfitz, and Noongar Elders Aden Eades, Averil Dean, Carol Pettersen, Ezzard Flowers, Lester Coyne, Lynnette Knapp and Treasy Woods.

As well as Noongar Elders, the team interviewed fire practitioners, volunteer brigade members and local landcare organisations to understand differing views of bushfire risk mitigation and how the knowledge and aspirations shared by the Noongar Elders could be applied.

In 2022, as a result of the project, the first Elder-led Noongar burn on Shire of Denmark reserves in generations took place.

"We used a collaborative, cross-disciplinary approach, focusing on working together to achieve outcomes for people and Country," Ms Rodrigues says.

"Semi-structured interviews and 'yarning' demonstrated that a highly nuanced knowledge of Country, including vegetation and fuel conditions, was necessary for achieving the desired outcomes of Noongar fire management.

"In all of the groups interviewed, fuel species, vegetation type, patchwork burning, specific fire placement and fire effects on vegetation were characteristic elements of conversation.

"Non-Noongar participants were concerned by authority to burn and the regulation of burning by governments. Local landcare groups shared a focus on land stewardship with Noongar Elders. Elders and fire practitioners shared practical concerns of fuel consumption, site preparation and fuel load."

Ms Rodrigues said the research process created space for participating Noongar Elders to reconnect with the reserves and the knowledge of fire passed down to them through generations, and to participate in discussions around a Noongar-led approach for the rejuvenation of cultural fire.

"The Elders' requirements and recommendations were forwarded to the Shire of Denmark and a pamphlet co-developed to explain the process and findings of the research to interested community members and volunteer fire fighters," she says.

The research led to a Noongar-led burn in the study reserve where, in a symbolic gesture, the Shire's Deputy Bushfire Control Officer handed a box of matches to Menang Nadju Elder Carol Pettersen, who lit the fire.

Ms Pettersen's grandson, Matt Palfrey, and Shawn Colbung, both of Binalup Noongar Rangers, finished the job, demonstrating their methodology to the volunteer fire fighters and fire practitioners present.

"I see this as an opportunity for a two-way learning," Ms Pettersen says. "Listening to the old cultural ways of doing things which were in practice for thousands of years and looking at how Western science is used today."

This year, as part of Ms Rodrigues' PhD project, *Caring for People, Country and Communities with Noongar Cultural Fire*, burns will take place in the Fitz-Stirling region, between the Fitzgerald River and Stirling Ranges National Park about 100km east of Albany. The burns will take place on private land or land that is part of the Aboriginal Lands Trust.

"We are working very closely on this project with the Nowanup and the Gnowangerup Aboriginal Corporations," Ms Rodrigues explains.

"We will be monitoring ecological and social outcomes of the burns."

The project will eventually create opportunities to show the local community what they have been doing and to connect with fire brigades in the region.

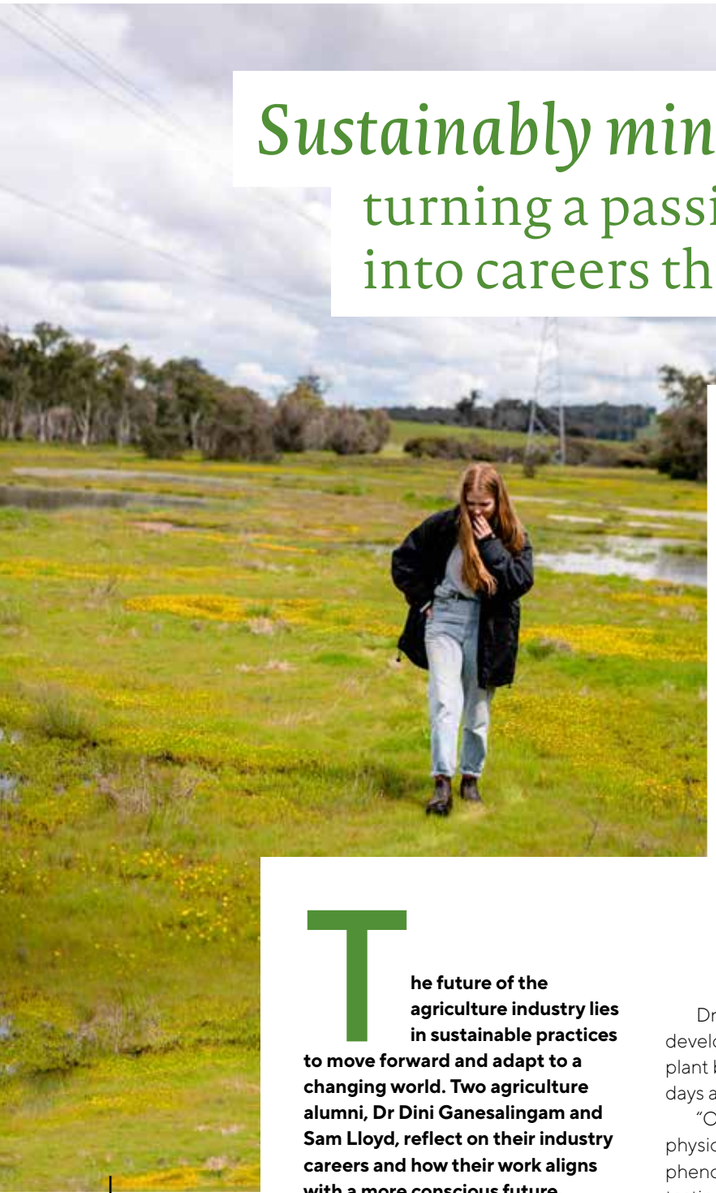
This project acknowledges funding contribution of the Commonwealth Government and support from the WA State Emergency Management Committee.

The *Walking Together Project*, supported by Lotterywest and funded by South Coast Natural Resource Management, is a collaboration with Noongar groups and families and the UWA Albany Campus. ■

Sustainably minded alumni

turning a passion for agriculture into careers they love

By Lauren Humfrey



Sam Lloyd

Dr Ganesalingam (centre) with colleagues Tress Walmsley and Dan Mullan

The future of the agriculture industry lies in sustainable practices to move forward and adapt to a changing world. Two agriculture alumni, Dr Dini Ganesalingam and Sam Lloyd, reflect on their industry careers and how their work aligns with a more conscious future.

Dr Ganesalingam was drawn to study agriculture, and specifically plant breeding, during a high school work placement scholarship run by Grains Research and Development Corporation (GRDC).

"It was an amazing experience working with UWA researchers on blackleg and chickpeas, and resulted in me signing up for a double degree in Agricultural Science and Economics at the end of it," Dr Ganesalingam said.

Dr Ganesalingam is now a research and business development manager at InterGrain Pty Ltd and says that plant breeding has provided a varied career where no two days are the same.

"Our occupation spans germplasm development, physiology, statistics, genetics, high throughput phenotyping (i.e. drones) through to end-products quality testing," Dr Ganesalingam said.

"It's an exciting challenge to constantly strive to produce the best variety package comprising yield."

Ms Lloyd is a laboratory technician at CSIRO with a generational connection to agriculture.

"The connection I feel to the land runs very deep and it informs a different life that I can't compare to anything else," Ms Lloyd said.

Ms Lloyd's graduate position came about after a UWA Agricultural Science tour of CSIRO laboratory facilities.

"A large part of the CSIRO laboratory research I'm now involved in investigates reducing sheep methane emissions through a number of investigative practices," Ms Lloyd said.

> Less methane from sheep farming equals less of an environmental impact and a better and more sustainable way to farm.

"Less methane from sheep farming equals less of an environmental impact and a better and more sustainable way to farm."

In both Dr Ganesalingam and Ms Lloyd's work, they can envision a sustainable future for agriculture.

"The methane emissions from livestock farming play a large part in the changes I'm seeing take place in the industry," Ms Lloyd said.

"While it's not an overnight fix, investigating alternative food sources for livestock that still meet the nutritional requirements and are financially sound, while also opening the door for an alternative food source that lowers methane emissions, is a great step towards sustainable farming.

"This is because methane is a greenhouse gas and traps heat in the Earth's atmosphere and environment, and also the energy lost through sheep emissions is wasted production and energy.

"Sheep that emit less methane use their food source more effectively and require less food. Less food needed for the same output is better for every step of the process.

"Alternative food sources such as seaweed and native plant-based sources aren't being used in the industry mainstream yet, but hopefully soon."

From Dr Ganesalingam's expertise and perspective, sustainability practices can also be addressed through plant genetics.

"Many people consider sustainability in a limiting sense and forget that genetics can help solve some of the environmental, social and governance (ESG) problems," Dr Ganesalingam said.

"While we don't have complete clarity in specific traits, we work with national and international partners to develop this.

"We're also in talks with UWA's Professor David Edwards to develop and expand our crop portfolio from predominantly cereals such as wheat, barley and oats, into pulses and oilseeds.

"This strategy can identify traits to contribute to ESG principles and also increase whole farm sustainability, via competitive options in crop diversity for farmers." ■

UWA's industry partnerships allow current students to bring their energy, passion and fresh perspectives into day-to-day operations at various Perth organisations.

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In the **frame**

Connected: our alumni, staff and students snapped at UWA events this year.
Stay in touch or update your details at:
alumni-update@uwa.edu.au

UWA **OPEN DAY**

UWA HOCKEY CLUB **100TH ANNIVERSARY**

In 2024 UWA Hockey Club will celebrate its centenary and we are seeking memories and photos from members past and present to mark this special occasion.

Any information or pictures since the creation of the University Women's Hockey Club in 1924, or the University Men's Hockey Club in 1929, would be appreciated.

Following a merger of the two clubs in the late 1980s, UWA Hockey Club has become one of the biggest and most successful clubs in Australia, an achievement worth commemorating.

We invite past players and supporters with a historic connection to UWA Hockey to join in the festivities and encourage you to get in touch with our huge network of members and alumni, including those still wielding a stick well into their 60s!

Centenary events will be held throughout 2024. Save the date for the UWA Hockey Centenary Cocktail Party on Friday 14 June 2024 at the University Club.

For more details, please contact UWAHC100@uwahockey.org.au

UNI CRICKET **RECOGNISES PAST AND FUTURE**

UWA's oldest sporting club had one eye on the past and another on the future when historic and recent figures were recognised at University Cricket Club's annual wind-up.

UWACC was founded in 1913 by Philip Le Couteur, a brilliant cricketer in Victoria and at Oxford University before he became UWA's inaugural lecturer in "mental and moral philosophy".

The club awards the Le Couteur Medal every season to its champion player, with leg-spinner Jay Chislett receiving the award after claiming 39 A-Grade wickets this season.

UWACC also honoured its colts team, which in February ended a 20-year drought by becoming the club's first premiership team since 2002-03. Three newcomers, including president Mitch Rosher, Josh Sharpe and Mitch Drennan, were inducted into the club's 100-game list.

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- Bachelor of Science

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