

The UWA Institute of Agriculture



While addressing the 200-strong crowd at the UWA Shenton Park Field Station 2022 Open Day, UWA Vice Chancellor Professor Amit Chakma emphasised the facility's long history and importance to the science and agriculture industries of WA.

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AUSTRALIA**

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From the Director

I had the pleasure of addressing a large group of research and professional colleagues at a vibrant morning tea hosted by The UWA Institute of Agriculture last week. Although I kept my speech brief, to highlight and celebrate a handful of achievements and successes this year, there was enough material to have spoken for an hour or more.

Congratulations to all recent award recipients, particularly the seven UWA researchers in agriculture and related areas named on the prestigious 2022 Clarivate Highly Cited Researcher list (page 18). Through our communications, such as this biannual newsletter, it is important to maintain a record of the hard work that is the beating heart of the Institute.

I encourage you to turn to pages 12 and 13 for a summary of the first public open day held at UWA Shenton Park Field Station in almost a decade. It was a joint initiative by the Institute and UWA School of Agriculture and Environment and a tremendous example of how collaboration helps us accomplish common goals. An abundant

harvest is currently underway at UWA Farm Ridgefield, which is reflective of one of our most positive and productive years for research and community engagement at the farm in recent history. It is host to many important externally funded research projects within the Best Practice Farming Systems Project.

It will be the end of an era when Western Australia's Minister for Regional Development, Agriculture & Food and Hydrogen Industry the Hon Alannah MacTiernan MLC retires from politics. We warmly wish Minister MacTiernan all the very best in her future endeavours and look forward to welcoming her successor Minister Jackie Jarvis MLC in 2023.

There are dozens of people to acknowledge for their tireless contributions: members of the Institute's Management Board, Industry Advisory Board, Theme Leaders, committees, members, and staff. My best wishes for a restful festive season and very happy New Year.

Hackett Professor Kadambot Siddique

AM CitWA FTSE FAIA FNAAS FISPP FAAS FPAS
kadambot.siddique@uwa.edu.au

Heartfelt tribute to Dr Roger Barroga

A moving reception to acknowledge former UWA PhD candidate Dr Roger Barroga's posthumous degree conferral was hosted by Vice Chancellor Professor Amit Chakma in November.

Guests of honour at the special event were Dr Barroga's wife Dr Karen Tanzo-Barroga and son Gio Anton Barroga.

The late Dr Barroga was awarded his Doctor of Philosophy six months after he suddenly and tragically passed away in 2020.

His thesis investigated the adoption and use of information and communications technology by farmers in major rice growing areas of the Philippines.



From left: Associate Professor James Fogarty, Professor David Pannell, Dr Karen Tanzo-Barroga, Professor Amit Chakma, Gio Anton Barroga, and Hackett Professor Kadambot Siddique.

Dr Barroga's supervisors were The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique and Professor Matthew Tonts.

Professor Siddique said he was personally very touched to memorialise his former student and meet with his family.

"I was very impressed by Roger's dedication to his postgraduate studies," Professor Siddique said.

"He was particularly inspired by the UWA Farm Ridgefield's Future Farm 2050 (now Best Practice Farming Systems) Project.

"When he returned to the Philippines, he converted five hectares of land into a model FutureRice farm that combines smart rice farming innovations and farm tourism."

Head of the UWA School of Agriculture and Environment Associate Professor James Fogarty and Professor David Pannell also attended the posthumous degree conferral.

"We carry with us in our hearts this very memorable, touching event in Roger's honour," Dr Tanzo-Barroga said.

"Aside from being an excellent academic institution, UWA cares for its students."

Pingelly Merino Lifetime Productivity Project wraps up at Ridgefield

Seven years of research as part of the Pingelly Merino Lifetime Productivity (MLP) Project culminated in a final field day at UWA Farm Ridgefield in late October.

The event attracted a crowd of about 80 farmers and researchers to hear results from the project and get one last look at the sheep involved in the trial.

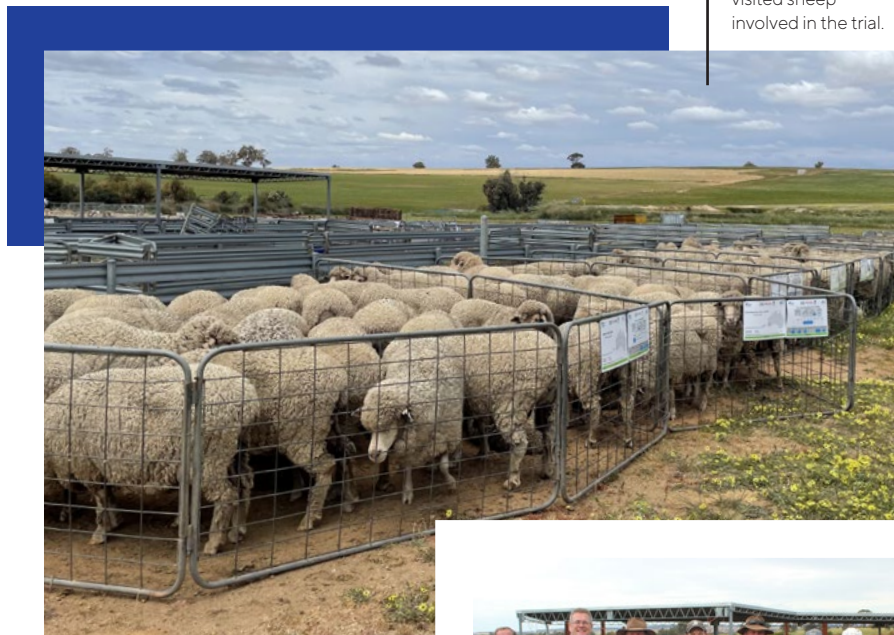
The Australian Wool Innovation (AWI)-funded and Australian Merino Sire Evaluation Association-facilitated MLP project – supported by Murdoch University, UWA, and the Federation of Performance Sheep Breeders along with the Site Committee – has run at Ridgefield since 2015.

Murdoch University Senior Research Fellow and MLP Pingelly Site Manager Dr Bronwyn Clarke said the ewe progeny born in 2016 and 2017 from 29 diverse Merino sires have now been evaluated for their lifetime productivity.

“Ewes were visually classed each year and had measurements taken for weight, condition score, wool quality, fleece weight, fat and eye muscle depth,” Dr Clarke said.

“Additionally, the ewes have been naturally mated each year and had their reproductive performance evaluated in terms of conception rate, number of lambs weaned and the weaning weight of their lambs.”

The field day was chaired by Site Committee Chair Brett Jones, who introduced a line-up of speakers including Dr Clarke, the University of New England’s Animal Genetics and Breeding Unit (AGBU) scientists Professor Daniel Brown, Dr Peter Wahinya



Field day attendees visited sheep involved in the trial.

and Dr Sam Walkom, as well as AWI’s Genetics Program Manager Geoff Lindon and MLP Project Manager Anne Ramsay.

In her presentation, Dr Clarke explained how early flock breeding values a good predictor of lifetime performance for wool and growth traits were, but reproduction traits weren’t as well predicted by just one or two measurements.

“Even though the project is coming to an end, the wool industry can look forward to the analysis and presentation of the results of such an important project continuing over the next four years.”

Dr Bronwyn Clarke

The AGBU presentations continued the reproduction theme looking at the effects of past reproductive performance on wool, growth, and body composition in the subsequent year and then the production traits influencing weaning rate breeding value.



Above: Presenters and stakeholders at the Pingelly MLP Project final field day.
Bottom left: Dr Bronwyn Clarke presenting in Avery’s Shearing Shed.



They also talked about how the MLP data nationally would impact breeding value estimation and the review of MERINOSELECT Indexes currently taking place.

Mr Lindon wrapped up the formal presentations outlining next steps for the MLP analysis.

The final part of the field day involved pen-side introductions and inspection of ewes from each of the sire groups.

Ewes at the UWA Farm Ridgefield site will have one last classing and shearing event before the conclusion of the trial.

Dr Bronwyn Clarke

bronwyn.clarke@murdoch.edu.au

A farming family show off their harvest.



“The pandemic caused a significant disruption in the production and marketing of cauliflower and broccoli in Aileu.”

Professor Vicente de Paulo Correia



Broccoli and cauliflower farm in the municipality of Aileu, Timor-Leste.

Broccoli and cauliflower market turned on its head in Timor-Leste

Broccoli and cauliflower farmers in the municipality of Aileu, Timor-Leste had their livelihoods challenged during the COVID-19 pandemic.

Broccoli and cauliflower farmers in the municipality of Aileu, Timor-Leste had their livelihoods challenged during the COVID-19 pandemic.

A study funded by the Australian Centre International Agricultural Research (ACIAR), led by National University of Timor-Lorosa'e (UNTL) and in collaboration with UWA has examined how the pandemic affected Aileu vegetable growers, in producing and marketing their goods to the main markets in Dili.

The research project partnered with UWA to provide guidance and support in conducting the project, which aimed to determine how farmers could better deal with issues caused by the pandemic and offer potential solutions, recommendations and lessons learned.

UWA Centre for Agricultural Economics and Development Associate Professor Fay Rola-Rubzen said she and her fellow researchers found that most producers experienced financial insecurity during the COVID-19 State of Emergency and lockdown in Timor-Leste.

The main impacts were economic losses due to difficulties in marketing the products to the main market, and complications in managing production systems through reduced access to inputs, such as seeds.

“The restrictions imposed on the community to reduce the spread of COVID-19 didn't deter the farmers to continue producing cauliflower and broccoli and finding markets, but it did lower the quality of the products,” Associate Professor Rola-Rubzen said.

Ordinarily, men and women farmers supplied their goods into the market through supermarket and mini markets, traders and collectors.

Supplying directly to supermarkets is the most preferred channel for the producer, however during the pandemic, this process

faced new challenges in terms of limited quantity of the product needed, timing of delivery, prices, and level of trust.

UNTL Faculty of Agriculture Professor Vicente de Paulo Correia said this trust-based relationship was tested during the pandemic.

“The pandemic caused a significant disruption in the production and marketing of cauliflower and broccoli in Aileu including lack of supply of the product, delays in the distribution channels, low demand and low prices,” Professor Correia said.

“All of these resulted from the lack of access to transport, lack of access to market and lack of movement of people and transportation.”

The research team presented the preliminary results of the study to stakeholders during a seminar in Aileu earlier this year.

The Dean of UNTL's Faculty of Agriculture, Director of Ministry of Agriculture and Fisheries (Aileu), and Administrator of the Municipality of Aileu Vila were among the 50 attendees.

Participants also included lead farmers, farmers' representatives, NGO staff, extension workers, Ministry of Agriculture and Fisheries (Dili, Timor-Leste), government department staff, heads of villages, traders, collectors and UNTL research students.

Associate Professor Fay Rola-Rubzen
fay.rola-rubzen@uwa.edu.au

Switched-on farmers the key to continued agriculture boom

With one of the biggest harvests in WA history on the horizon, Ian McClelland shared his increasingly optimistic outlook at the 2022 Hector and Andrew Stewart Memorial Lecture.

A packed lecture theatre of almost 100 people turned up to hear the Birchip Cropping Group (BCG) founder deliver the 28th lecture for The UWA Institute of Agriculture in October.

Mr McClelland, who was the 2004 recipient of the GRDC Seed of Light Award, travelled from his 8300ha mixed cropping farm in Birchip, Victoria to share his insights.

His lecture traced the history of farming in Australia and WA, celebrated its current boom times, and looked forward to the future.

Set to a scrolling backdrop of BCG photos taken over the past 30 years, Mr McClelland reminisced about a time when many financial counsellors wouldn't invest in agriculture.

"Now, we suddenly have investments by superannuation funds and big corporations," he said.

"They are investing higher than they ever have in the history of agriculture."

Mr McClelland said farmers had always benefitted from science and technology – now more than ever.

"We have many new crops to plant, an advanced understanding of farming systems research, and can now make

informed on-farm decisions based on history, data, weather forecasts and individual expertise," he said.

"Even so, the future poses many challenges, including the impact of climate change, and significant gap between potential and actual yields based on water-use efficiency."

Mr McClelland said WA would continue to see good results in the condition that farmers continued to educate themselves and be innovative.

He mentioned that BCG spent about 30 per cent of their income on farmer extension and education regarding more efficient farming practices.

"I think today's farmer is much more switched on in relation to the science that is making agriculture a boom industry," he said.

The UWA Institute of Agriculture holds this lecture in honour of the late Hon Hector J Stewart, MLC and his son, the late Andrew M Stewart.

Mr Stewart Jr was President of UWA's Guild of Undergraduates in 1929 and twice Dean of UWA's Faculty of Agriculture.

Following the lecture, Stewart family and friends gathered for a sundowner with UWA leaders and special guests in the UWA Science Common Room.

Watch this lecture on The UWA Institute of Agriculture's YouTube channel.

Ian McClelland delivering the 2022 Hector and Andrew Stewart Memorial Lecture.



Hackett Professor Kadambot Siddique with Australian Ambassador to Iraq Paula Ganly at UWA.

Bond fortified by visit from Australian Ambassador to Iraq

The partnership between The UWA Institute of Agriculture and the Higher Committee for Education Development in Iraq is stronger than ever following a special visit from the Australian Ambassador to Iraq Paula Ganly in October.

Ms Ganly and the Institute Director Hackett Professor Kadambot Siddique discussed UWA's engagement and collaboration with Iraq since 2005.

This long-time association includes training Master's and PhD students, delivering masterclasses, and numerous collaborations in dryland agricultural research.

"Paula was very impressed with the work we have done in Iraq," Professor Siddique said.

"She is looking forward to developing further partnerships with Iraqi universities to build capacity in applied and strategic joint research."

Fully funded by the Iraqi Government, 15 Iraqi students have completed English language training and their PhD studies in agriculture and related areas at UWA since 2005.

UWA has also trained 25 Master's students funded by the Australian Government.

Study unearths state of soil health in community gardens

Community gardens having been sprouting up all over Perth in recent years.

They provide a common space where people come together to grow food, foster good health, and green urban environments, support life-long learning and cultivate vibrant communities.

UWA School of Agriculture and Environment Honours student Haochen Zhao is examining soil health and carbon storage in community gardens located in the Perth metropolitan area.

His research project is supervised by Professor Nanthi Bolan and Dr Bede Mickan, and includes Perth City Farm, North Fremantle Social Farm, Murdoch Community Garden, West Leederville Community Garden, Earthwise Community and Glyde-In Garden Gnomes.

Although community gardens primarily promote sustainable horticulture and conservation agriculture practices, Mr Zhao said research on soil health and carbon sequestration potential in community gardens was limited.

"Soil carbon sequestration contributes to mitigating the impacts of climate change resulting from greenhouse gas emission," he said.

For this study, soil samples were collected from the six community gardens covering three Soil Mapping Units (calcareous deep



Plentiful crops growing at North Fremantle Social Farm.

UWA Honours student Haochen Zhao with Professor Nanthi Bolan.

sands, coloured sand and pale sands) including control plots (bare ground next to raised beds) and raised beds (gardening area).

Soil samples of raised beds and control plots were characterised for various soil physical, chemical and biological properties.

Soil carbon storage was then calculated based on bulk density and the total carbon content of the soil.

The soil samples from raised beds had lower bulk density and loamy texture.

They also had higher pH buffering capacity, available nutrients (including nitrogen phosphorus and potassium), cation exchange capacity, total carbon, and microbial biomass.

Mr Zhao said this indicated that soils in community gardens maintained higher soil health parameters.

"In addition, raised bed soils accumulated higher levels of carbon, indicating that community gardens provide a potential source of carbon sequestration," he said.

"The improved soil health and carbon storage in community garden soil can be attributed to the regular application of compost produced within the community gardens."

Haochen Zhao
22561516@student.uwa.edu.au

Vitamin K1 kicks goals for bone strength

Older women who eat a diet rich in vitamin K1 are more than 30 per cent less likely to fracture a bone, according to a recent collaborative study from Edith Cowan University and UWA.

The research team looked at the relationship between fracture-related hospitalisations and vitamin K1 intake in about 1400 older Australian women over a 14.5-year period from the Perth Longitudinal Study of Aging Women.

They found that women who ate more than 100mg of vitamin K1 (equivalent to about 125g of dark leafy vegetables) were 31 per cent less likely to have any fracture compared to participants who consumed less than 60mg a day – which is the current recommended intake.

Study participants who ate the most vitamin K1 cut their risk of hospitalisation almost in half (49 per cent).

Research lead Dr Marc Sim from ECU and an Adjunct Research fellow at UWA said the results were further evidence of the benefits of vitamin K1, which has also been shown to enhance cardiovascular health.

"Our results are independent of many established factors for fracture rates, including body mass index, calcium intake, Vitamin D status and prevalent disease," he said.

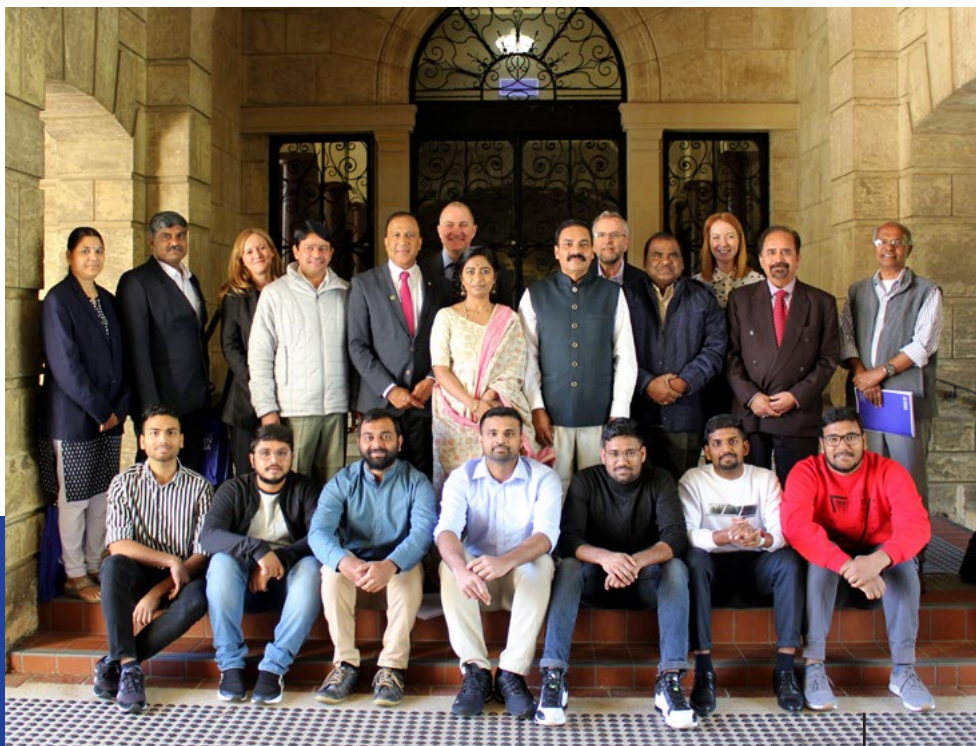
"Basic studies of vitamin K1 have identified a critical role in the carboxylation of the vitamin K1-dependant bone proteins such as osteocalcin, which is believed to improve bone toughness."

Celebrating the fruits of UWA-ANGRAU partnership

Leaders from Acharya N.G. Ranga Agricultural University (ANGRAU) in Andhra Pradesh, India were delighted to meet with ANGRAU postgraduate students at a special meeting hosted by The UWA Institute of Agriculture in October.

The Government of Andhra Pradesh's Minister for Agriculture, the Honourable Sri Kakani Govardhan Reddy, and Consulate-General of India (WA) Consul Naresh Sharma attended alongside ANGRAU Vice Chancellor Dr A Vishnuvardhan Reddy, Registrar Dr G Rama Rao, Agricultural Extension Professor Dr K Gurava Reddy and Agricultural Engineering College Associate Dean Dr A Mani.

UWA Deputy Vice Chancellor (Research) Professor Anna Nowak joined the Institute Director Hackett Professor Kadambot Siddique, Global Engagement Office Associate Director David Connell, Global Engagement Office Manager Annabel Turner, the Institute Associate Director Professor Wallace Cowling, Professor Nanthi Bolan, Professor Shane Maloney, International Recruitment, Future Students, Brand Marketing and Recruitment Head Michelle Teasdale and PhD candidate Sneha Priya Pappula Reddy to discuss potential areas for future research collaboration and capacity building.



Leaders from Acharya N.G. Ranga Agricultural University and UWA, PhD students and esteemed guests outside UWA's Winthrop Hall.

Following the meeting and exchange of gifts, the postgraduate students joined the special guests for morning tea refreshments.

Bean breeders benefit from two-week training trip

After a long flight from Uganda to Perth, researchers Dr Clare Mukankusi and Winnifred Amongi were full of beans when they arrived at UWA's Crawley campus in October.

Bean Breeding Global Lead Dr Mukankusi and bean breeder Ms Amongi, from the Alliance of Bioversity and CIAT (International Center for Tropical Agriculture), are part of The Australian Centre for International Agricultural Research (ACIAR)-funded

project to accelerate breeding of healthier and faster-cooking African common beans.

The ACIAR project supported their recent visit to Australia for two weeks of training in genetics and breeding.

Training was taught by UWA research associate Dr Renu Saradadevi, followed by Dr Li Li and Emer Prof Brian Kinghorn at the University of New England (UNE) in New South Wales.

The UWA Institute of Agriculture Associate Director and ACIAR project leader Professor Wallace Cowling said it was a very eventful and positive fortnight.

"There was vigorous discussion on the role of quantitative genetics in optimising crop breeding at a joint UNE-UWA student-staff



Professor Wallace Cowling, Dr Clare Mukankusi, Winnifred Amongi, Dr Renu Saradadevi and Hackett Professor Kadambot Siddique.

symposium in crop breeding," Professor Cowling said.

"At UNE, we were joined by UWA School of Agriculture and Environment PhD students Felipe Castro Urrea and Mukesh Choudhary."



The cohort at Shenton Park Field Station with members of the CEI:AgER, including Director Associate Professor Andrew Guzzomi.

Students sow seeds of curiosity

By Guanhao Cheng

An enthusiastic cohort of students from four of WA's agricultural colleges toured UWA's Crawley campus and Shenton Park Field Station in October.

UWA Emeritus Professor Graeme Martin led school staff and students from Narrogin, Cunderdin, Harvey and Kelmscott on a guided walk – stopping at Winthrop Hall, the Old Cricket Pavilion, School of Molecular Sciences' Bayliss Building and UWA glasshouses.

UWA researchers and undergraduates enriched the experience by sharing details of their latest experiments.

Every student went home with a showbag from The UWA Institute of Agriculture, which included their latest newsletter,

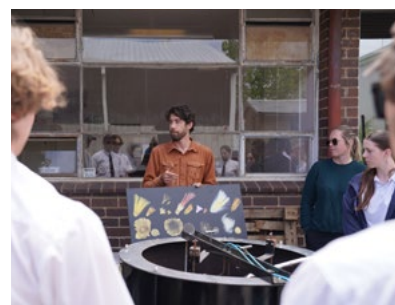
flyers, pens and UWA School of Agriculture and Environment course guides.

Following the campus tour, the group made their way to UWA's Shenton Park Field Station.

At the research facility, they toured multiple active research projects at the new Centre for Engineering Innovation: Agriculture & Ecological Restoration (CEI:AgER) and learned about how researchers are using black soldier flies to turn waste into sustainable products.

WA College of Agriculture - Narrogin head of teaching and learning Leanne Sjollema said the feedback she received from staff, students and teachers was very positive.

"When asked to rank their favourite sessions, it was a fairly even split between the Engineering Centre at Shenton Park,



Dr Monte Masarei explaining to students how biological research can guide machine design.

the Electromagnetic induction machine exhibition, the glasshouses tour, and meeting current students," Ms Sjollema said.

"I have had some very positive emails back from parents about the value of the trip as a whole and they really valued the positivity that the students came away with.

"They specifically appreciated the opportunity for their children to see what it is that they may be working towards over the next two years."

The excursion gave the students an understanding of the alternate university pathways available when they graduated from their secondary studies.



FGS Chief Financial Officer Nik Zairidin, Managing Director Luke Wheat and Kate Chaney MP.

Pretty fly for a sustainability ally

Holding a handful of wriggling black soldier fly larvae might have been more than Member for Curtin Kate Chaney MP bargained for during a recent visit to UWA Shenton Park Field Station.

Future Green Solutions (FGS) founder and Managing Director Luke Wheat said Ms Chaney expressed a keen interest in their research base at Shenton Park, which is within her electorate.

"Kate is a big advocate of sustainability and climate change and was thoroughly impressed with how FGS has monetised sustainable solutions to waste and protein in one business model," Mr Wheat said.

"We talked her through our journey, the important collaboration with UWA and our vision for what is next."

FGS have partnered with UWA on several research projects, such as using black soldier fly to convert livestock waste into profitable products led by UWA Associate Professor Marit Kragt.

Research journey sharpens focus on sustainable future

Environmental economics is a powerful lens to help us to understand the positive and negative impacts of policy or planning decisions, says UWA Natural Resource Management PhD candidate Alaya Spencer-Cotton.

Ms Spencer-Cotton recently submitted her thesis, under the guidance of supervisors UWA Associate Professor Marit Kragt, Professor Michael Burton and Dr Jorge Alvarez-Romero.

For her PhD research, she explored the values and preferences that the Australian public had for different rangelands land-uses in the Kimberley region of Western Australia.

“The preferred future of the Kimberley rangelands includes a diversity of land-uses and promotes economic growth that maintains the natural landscape, while supporting the ecological and cultural values of the region,” she said.

Having started out studying environmental and marine science, Ms Spencer-Cotton was working for an environmental non-government organisation when she discovered her true research calling.

“At that time it occurred to me that, in some ways, no amount of scientific understanding about human-environment interactions will necessarily help us make better decisions,” she said.

“I have always been interested in understanding how humans interact with the environment around them.”

“I became interested in the interaction itself and the human values part of the interaction, which led me toward economics and economic theory.”

Ms Spencer-Cotton said she strongly believed that society could collectively make decisions to create a more sustainable future for everyone.



UWA PhD candidate Alaya Spencer-Cotton.

“Using a variety of lenses and tools to understand all the impacts of decisions can help us make these decisions,” she said.

“These are often derived from different ways of being in and seeing the world.

“Environmental economics is just one lens, and it can be a powerful one, for helping us to understand all the positive and negative impacts of policy or planning decisions.”

While reflecting on her postgraduate journey, Ms Spencer-Cotton said the highlight was meeting so many inspiring and interesting people who work in agricultural and resource economics around the world.

“They are resourceful, passionate people that care about creating a better world for everyone to share,” she said.

Alaya Spencer-Cotton

alaya.spencer-cotton@research.uwa.edu.au



Microplastics such as these are ubiquitous and damaging to the environment.

Microplastics in soil and air: Research ripe for the picking

Given the majority of microplastics research is focused on marine and freshwater abundance, Professor Meththika Vithanage is urging scientists to turn their attention to investigating microplastics in soil and air.

The UWA Institute of Agriculture Adjunct Professor made this call to arms during her October lecture at UWA on *Microplastics in the Environment: Challenges and opportunities in environmental research*.

Professor Vithanage is the founding Director of the Ecosphere Resilience Research Centre, University of Sri Jayawardenepura, Sri Lanka and an Adjunct Professor at the University of Petroleum and Energy Studies, India.

She said microplastics in the size range from 100 μm to 5 mm were ubiquitous in the environmental triad: soil, water, and air.

"Application of plastic mulch film, compost and biosolids into agricultural soils induce a threat to soil physico-chemical and biological properties," she said.

"Microplastics in the water environment may also act as a vector transporting various pollutants from one place to another."

Professor Vithanage said microplastics posed many challenges to the environment.

"Microplastics can interact with antibiotics and there is a possibility of developing antibiotic microbial resistance in the environment," she said.

"Municipal waste landfills, agricultural lands, and traffic acts as sources for atmospheric microplastics."

Microplastics and plastic additives such as plasticisers may end up in the food web, bioaccumulate and cause health risks.

However, Professor Vithanage said there were limited studies on the effect of microplastics in soil and air.

"Most of the literature focus on reporting the abundance, and hence there are ample opportunities for multidisciplinary and collaborative research related to microplastic and environmental health," she said.

During her week-long visit, Professor Vithanage met with several UWA researchers and discussed potential areas of collaboration.

Watch this lecture on The UWA Institute of Agriculture's YouTube channel.

Professor Meththika Vithanage
meththika@sjp.ac.lk

Higher nitrate levels found in favourite fruits

You may rethink adding bananas and strawberries to your morning smoothie, according to an updated nitrate food composition database for plant-based foods co-created by researchers from UWA.

A collaborative research team hailing from UWA's Medical School and School of Biomedical Sciences, Edith Cowan University, Flinders University and the University of Sydney found that banana and strawberry contain far higher amounts of nitrate than previously recognised.

The paper, recently published in *Food Chemistry*, claimed that an up-to-date nitrate food composition database of plant-based foods was lacking.

There are both risks and benefits to human consumption of dietary nitrate and nitrite intake.

While observational studies have demonstrated a lower risk of cardiovascular disease with higher habitual nitrate intake, there are also possible detrimental effects of high nitrate intake.

"It is (therefore) imperative to obtain a robust assessment of dietary nitrate intakes and facilitate more empirical evaluation of health implications," the paper said.

The research team updated and expanded the 2017 vegetable nitrate database by including data published between 2016 and 2021, as well as data on fruits, cereals, herbs, spices, pulses and nuts (from 1980 to 2021).

Of the collated nitrate contents for 264 plant-based foods from 64 countries, 120 were obtained from three or more references.

Despite substantial variations, leaf vegetables were the top nitrate-containing foods, followed by stem and shoot vegetables, herbs and spices, root vegetables, flower vegetables, tuber vegetables, nuts, fruit vegetables, legume/seed vegetables, and fruits and cereals.



Bananas and strawberries contain far higher amounts of nitrate than previously recognised.



Sun shines for Indonesian delegates tour

It was a picture-perfect spring day for The UWA Institute of Agriculture to take a group of delegates from the University of Mataram (UNRAM), Indonesia on a tour of the UWA glasshouses last month.

The visitors included UNRAM Rector Professor Bambang Hari Kusumo, Vice Rector for Planning, Collaboration and Information System Dr Yusron Saadi, numerous esteemed heads of departments and faculties (such as Dean of the Faculty of Agriculture Dr Sudirman) professors and members of UNRAM senate.

The Institute's Director Hackett Professor Kadambot Siddique was joined by several UWA leaders including Head

of the UWA School of Agriculture and Environment Associate Professor James Fogarty, Professor Jacquie Batley, Associate Professor Theo Evans, Senior Technician (Research Infrastructure Platforms) Dr Emielda Yusiharni and Manager Internationalisation (Science) Annabel Turner.

At the glasshouses, PhD candidate Mohammad Salim explained how he was investigating the traits of soybean plants under drought and low phosphorus environments.

Prasanthi Sooriyakumar then introduced the group to her rye grass experiments that are part of her postgraduate research project to increase soil productivity by managing soil carbon.

Webinar chews on issues of sustainable food production and security

Do you know where your food comes from and how it got to your plate?

This was the central big picture question driving the UWA Public Policy Institute (PPI) webinar *Food production and security in a changing climate* in late August.

Facilitated and moderated by UWA PhD students Chris Crellin and Jemah Harrison as part of their internship with PPI, the panellists were Wide Open Agriculture Managing Director Dr Ben Cole, OzHarvest founder and CEO Ronni Kahn AO, Wheatbelt Development Commission Regional Development Director I-Lyn Loo, and Dr Caitlin Moore from the UWA School of Agriculture and Environment.

Ms Harrison said the webinar led to valuable discussions about the steps needed to mitigate against and adapt to food security challenges.

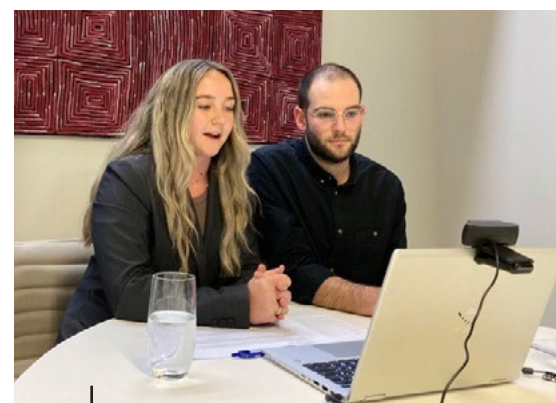
One of the key takeaways was driving home the bottom-up narrative.

"The power lies within the consumer and their purchasing powers and influence on food production," she said.

"It is important for consumers to think about where their food comes from, how it is used and being conscious about food waste.

"The need for investment and education across all sectors of the whole food system was an important theme."

The webinar also explored important alternatives for sustainable food production, such as breeding high performing and crops that are more resilient to changing climates, and regenerative agriculture that is focused on farming with nature, not against it.



UWA PhD students Chris Crellin and Jemah Harrison hosting the webinar.

One of the key takeaways was driving home the bottom-up narrative.

The University of Western Australia Shenton Park Field Station recently threw open its gates to the public for its first community open day in almost 10 years. The popular event was a joint initiative between The UWA Institute of Agriculture and UWA School of Agriculture and Environment.



Showcasing innovative research at Shenton Park Field Station

Anticipation was building as the clock ticked closer to the official opening of the UWA Shenton Park Field Station 2022 Open Day on September 23.

The formalities began with The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique welcoming attendees to the site, which has served the science and agriculture industries of WA for more than 60 years.

UWA Vice Chancellor Professor Amit Chakma took to the stage to introduce Parliamentary Secretary to Food and Agriculture Minister Alannah MacTiernan, the Hon Darren West MLC, to formally open the event.

As the only working farmer in the WA Parliament, Mr West expressed a professional and personal interest in a number of research projects on show.

Head of the UWA School of Agriculture and Environment Associate Professor James Fogarty then outlined the eight research project presentations – ranging from aquaculture to breeding canola for heat tolerance.

Students and locals alike made a beeline for the Future Green Solutions (FGS) stall to get up close and personal with black soldier fly larvae.

The FGS team explained how they use the critters to upcycle low-value organic waste into high-value products.

Just next door at the UWA Aquaculture Facility, UWA Oceans Institute and School of Biological Sciences PhD candidate Isobel Sewell delivered a presentation on how she was using BSF larvae in aquaculture diets.

Aspiring coastal engineers were keen to tour the 1900 m² multipurpose hydraulics laboratory space, which can simulate

offshore environments ranging from the deep ocean to shallow water.

The Coastal and Offshore Engineering Laboratory is used for a wide range of research, from testing performance of deep-sea vehicles to assessing stability of underwater cables.

During the Open Day, they demonstrated recent model testing techniques used for coastal and offshore engineering applications.

The event was one of the first opportunities for the public to visit The UWA Institute of Agriculture research theme leader Dr Andrew Guzzomi's new Centre for Engineering Innovation: Agriculture & Ecological Restoration.

Out in the field plots, UWA Associate Professor Phillip Nichols presented on the Annual Legume Breeding Australia (ALBA) project with Senior Research Officer Brad Wintle.





Nearby, Australian Herbicide Resistance Initiative Research Fellow Dr Roberto Busi presented on herbicide resistance in ryegrass.

In the shadehouses, Research Fellow Sheng Chen and Professor Wallace Cowling presented on their canola research projects – a GRDC-funded heat tolerance trial and the NPZ-UWA canola breeding partnership, respectively.

Information stalls run by Animal Care Services and the UWA School of Agriculture and Environment were kept busy answering questions about research and study at UWA, while the Students of Natural and Agricultural Sciences fundraiser sausage sizzle ensured no-one went hungry.

"The open day was an excellent opportunity to experience 'hands on' the research being undertaken at Shenton Park," event attendee Xavier said.

The hugely successful event, which was jointly organised and run by The UWA Institute of Agriculture and the UWA School of Agriculture and Environment, would not have been possible without the hard work and dedication of dozens of staff members and volunteers.

Photos (clockwise from left):

Associate Professor James Fogarty, UWA VC Professor Amit Chakma, Hackett Professor Kadambot Siddique and Forrest Research Foundation Director Professor James Arvanitakis.

PhD candidate Isobel Sewell.

The Hon Darren West MLC at the Coastal and Offshore Engineering Laboratory.

Associate Professor Wallace Cowling.

Dr Andrew Guzzomi at the CEI:AgER.

Postgraduate student volunteers.

A group gathers for Dr Roberto Busi's presentation.

Impact of virus infection on plant species mixtures needs renewed attention

What occurs when different plant species grow side-by-side in a managed or natural ecosystem and one of them becomes infected and weakened by a virus disease?

Although past research on the impact of this scenario has been largely forgotten, The UWA Institute of Agriculture Adjunct Professor Roger Jones is on a mission to rectify this.

"This research question is important both for economically significant, mixed species managed pasture systems and for environmentally significant mixed wild species populations," Adjunct Professor Jones said.

"Moreover, it is important not only for the success of regenerative agriculture in addressing climate change, but also for maintaining biodiversity in threatened natural ecosystems."

In his article published in *Plant Pathology*, Adjunct Professor Jones traced a series of past field experiments with pasture plant species mixtures and found that the delicate balance between different species was disrupted by virus infection.

This was because the diseased species was no longer able to compete with non-host species, so the proportion of it diminished whereas non-hosts increased.

"The same thing also occurred when the different pasture plant species present were both susceptible to infection, but one was virus-sensitive and another was virus-tolerant," he said.

"This resulted in the virus-tolerant species increasing at the expense of the virus-sensitive species."

Both scenarios also occur when virus-sensitive, susceptible pasture species compete with non-host or virus-susceptible but tolerant weed species, which results in 'pasture decline' due to takeover by weeds of little value as livestock feed.



A row of annual pasture medic with vigorously growing healthy plants at back versus small, stunted virus-infected plants at front.



Virus-infected annual pasture medic completely outcompeted by capeweed (yellow flowers) and grass weeds.

"Virus disease can not only replace the optimal balance between different pasture species with a sub-optimal one, but also accelerate pasture decline due to weed invasion," Adjunct Professor Jones said.

"This in turn depletes a pasture's livestock-feed value and diminishes its ability to improve soil health or remove carbon dioxide from the atmosphere or soil.

"The solution to this problem requires greater attention being paid to the application of existing but neglected control measures that prevent virus introductions and minimise virus spread. This applies to both managed and natural plant populations."

Adjunct Professor Roger Jones
roger.jones@uwa.edu.au

Deep-rooted systems for deep soils in the West Midlands



UWA Master's student Adam Anfuso has identified a novel option for West Midlands farmers with deep sandy soils to better utilise stored soil water and nutrients and increase grain production.

Mr Anfuso started his Master of Agricultural Science degree at UWA while working full-time for the West Midlands Group in 2021.

His supervisors were West Midlands Group Executive Officer and The UWA Institute of Agriculture adjunct lecturer Dr Nathan Craig and UWA School of Agriculture and Environment Associate Professor Ken Flower.

For his research project, Mr Anfuso monitored two trial sites in the West Midlands region of Western Australia (Badgingarra and Regan's Ford) that were established on deep sandy soils more than three metres deep.

Both sites had previously been limed and deep-ripped (one also spaded) to alleviate subsoil constraints.

The trials compared early (mid-April and early-May) and standard (mid-May and early-June) seeding dates of about six to eight wheat varieties with different maturities ranging from short-medium

(such as *Vixen* or *Scepter*) through to long (*Longsword* or *Illabo*).

The 2021 growing season had good rains and a soft finish, which allowed even the late seeding times to achieve high yields, with most varieties yielding above five tons per hectare.

"The longer vegetative stage of long-maturing varieties resulted in increased rooting depth," Mr Anfuso said.

"This then led to an increase in soil water and nitrogen uptake when varieties were sown near their optimum sowing window i.e., early sowing for long maturing varieties.

"The study showed the potential to extend the sowing window for wheat production in WA, allowing for better management decisions for optimising sowing dates and flowering times."

Adam Anfuso
23309225@student.uwa.edu.au

A drone photo of Mr Anfuso's Badgingarra trial site.



UWA Master of Agricultural Science student Adam Anfuso.

FAO symposium fosters dialogue, learning and collaboration

A focus on 'resilience, sustainability, inclusiveness and efficiency' was cornerstone to the Food and Agriculture Organization of the United Nations (FAO) Regional Knowledge Platform on One Country One Priority Product (OCOP) at the Asia-Pacific Symposium on Agrifood Systems Transformation in October.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique travelled to Bangkok in Thailand for the two-day symposium.

Professor Siddique was one of six experts from member countries research institutes to present at the FAO Regional Knowledge Platform.

The event aimed to showcase successful experiences in sustainable development of Special Agricultural Products (SAPs) in the Asia-Pacific, demonstrated the varieties and effectiveness of SAPs and strengthen partnership on OCOP.

In his presentation, Professor Siddique emphasised the importance of pulses and advocated bringing back 'forgotten' crops, referencing the fact that Thailand has successfully reduced malnutrition by diversifying its food basket.

In summary, he called for more research and development funding, increased incentives for enhanced technology, effective trade, improvement in yield and value chain for the benefits of producers and consumers, and private sector investment.

"It was my pleasure to attend this very important symposium," Professor Siddique said.

"The FAO is mobilising existing knowledge, expertise and best practices from the Asia-Pacific region to foster dialogue, learning and collaboration."

During the symposium, Professor Siddique interacted with Agriculture Ministers and Government officials from various countries in the Asia-Pacific Region.



Hackett Professor Kadambot Siddique with fellow presenters at the Asia-Pacific Symposium on Agrifood Systems Transformation.



The convergence workshop at Kathaili in Jalalgarh, India.

Associate Professor Fay Rola-Rubzen.



Tackling farmers' uptake of tech with behavioural economics

What role does behavioural economics play in farmers' decisions to adopt Agriculture Sustainable Intensification (CASI) technologies?

Associate Professor Fay Rola-Rubzen from the UWA Centre for Agricultural Economics and Development (CAED) is leading The Farmer Behaviour Insights Project (FBIP) to find out.

The multi-disciplinary team of scientists have been studying the value of behavioural economics in technology adoption in South Asia for a research project funded by the Australian Centre for International Agricultural Research (ACIAR).

UWA has partnered with government, research and agricultural organisations based in Nepal, India, and Bangladesh to share the knowledge generated under FBIP research, including ways to improve the uptake of CASI.

In June, FBIP partner institute Uttar Banga Krishi Viswavidyalaya and the State Department of Agricultural Economics and Central Leadership convened a one-day online international workshop titled *Behavioural Insight in CASI Adoption – What, Why & How?*

Another FBIP research partner, Bihar Agricultural University (BAU), collaborated with Zero Budget Natural Farming and the Bhola Paswan Shastri Agricultural College for a two-day event earlier in the year, including an orientation program and a convergence workshop in Jalalgarh, India.

More than 125 dignitaries, scientists and farmers attended the convergence workshop.

Each of the 50 women farmer participants were gifted a fruit plant sapling for encouragement and appreciation.

The presentations discussed CASI and the benefits to farming communities, including soil health and reduced irrigation costs.

BAU reiterated their commitment to help double farmers income, which would help increase adoption of new agricultural technologies.

Associate Professor Rola-Rubzen said it was clear behavioural economics played a critical role in improving technology adoption.

"Continued communication and engagement across the various stakeholder groups is essential," she said.

"Improved understanding about CASI adoption obtained through FBIP by applying behavioural economics is now being transferred for use by policy makers, program managers, investors, and the scientific community."

"Our partner organisations are engaging governments, research institutions and agricultural organisations to share the knowledge generated under FBIP research."

Associate Professor Fay Rola-Rubzen
fay.rola-rubzen@uwa.edu.au

Groundwater challenges run deep for agricultural development

There was great synchronicity in the timing of Associate Professor Ofer Dahan's lecture on groundwater protection & agricultural development at UWA last month.

While Associate Professor Dahan delivered his presentation, the Vadose-Zone Monitoring Systems (for real-time contaminant migration and water flow tracking) he developed at his company Sensoil Innovations were being shipped to UWA for the Australian CZO network (OZCZO) project.

The OZCZO project is led by The UWA Institute of Agriculture's Water for Food Production theme leader Associate Professor Sally Thompson.

Associate Professor Dahan is a visiting UWA Fellow from the Zuckerberg Institute for Water Research at Ben-Gurion University of the Negev in Israel.

He specialises in research on vadose zone hydrology, land use impact on groundwater quality, remediation contaminated soils, and the development of subsurface monitoring technology.

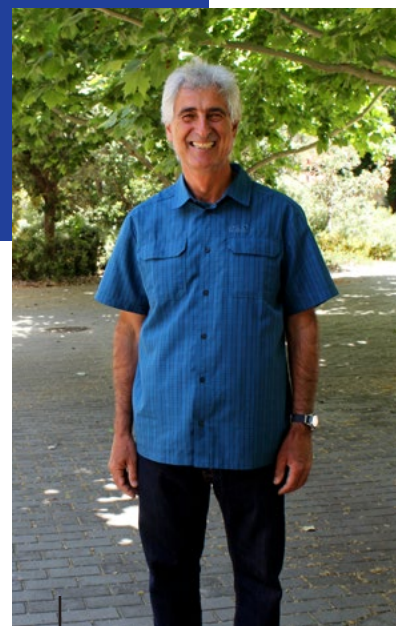
In his lecture, Associate Professor Dahan explained that achieving efficient and productive agriculture while preserving water resources quality was one of the most important challenges in water resources management.

“Groundwater protection and agricultural development creates conflict, and that conflict needs to be properly managed.”

“Nitrate pollution, which is associated with excess fertilisation, is a global threat to water quality and availability,” he said.

“Nevertheless, fertiliser application in agriculture still relies primarily on farmer's experience and expert's recommendations, and not on the actual soil nutrient availability.”

The global scale of excess fertilisation reaches about 50 per cent of the required plant uptake, which results in severe water resources pollution and massive release of greenhouse gases to the atmosphere.



Associate Professor Ofer Dahan outside the UWA Agriculture Lecture Theatre.

Associate Professor Dahan said the development of efficient and reliable monitoring tools were critical to optimise fertiliser application and reduce water resources pollution.

“These tools are capable to provide real-time information on the soil nutrient state and the quality of water percolating through the unsaturated zone,” he said.

Watch this lecture on The UWA Institute of Agriculture's YouTube channel.

Associate Professor Ofer Dahan
odahan@bgu.ac.il

Round-up of BeefLinks research at GCG Pastoral Forum

Updates on the BeefLinks project took centre stage at the 11th annual Gascoyne Catchments Group Pastoral Forum in Coral Bay last month.

BeefLinks is a collaborative research and development (R&D) partnership involving Meat & Livestock Australia (MLA), the MLA Donor Company (MDC) and UWA.

Led by The UWA Institute of Agriculture Associate Director Professor Philip Vercoe, the four-year research project is delivering an integrated and complementary R&D program for northern and southern production systems across WA.

More than 75 people attended the Forum to hear 15 expert presentations on a wide range of topics, including pastoral resilience, markets and profitability, research and technology and other relevant projects in the region.

Professor Vercoe gave an update on the Australian-first virtual fencing trials, which stirred discussions on the different ways this technology could assist in the landscape.

He also updated the audience on the CN30 project and what the Zero Net Emissions Collaborative Research Centre (CRC) could mean for the beef industry.

BeefLinks partner West Midlands Group Beef Industry Development Officer Erin O'Brien provided a wrap-up of their backgrounding project, which aims to build a higher value beef supply chain in WA by linking pastoral beef to high-value markets.

Also in attendance were UWA researchers involved in the recently launched BeefLinks project *Producer insights for adoption outcomes across WA*.

The team handed out flyers and spoke with producers and pastoral managers to encourage them to participate in interviews and provide feedback on increasing adoption of on-farm innovations in livestock management.



Professor Philip Vercoe taking notes at the 2022 Gascoyne Catchments Group Annual Pastoral Forum.

Biochars super charge remediation of contaminated water and soil



PhD candidate Basit Ahmed Khan in a UWA lab.

Pristine and engineered biochars are an effective adsorbent to remediate anionic contaminants present both in water and soil, according to UWA-based research.

Visiting PhD candidate Basit Ahmed Khan from Quaid-i-Azam University Islamabad in Pakistan recently conducted experiments at UWA for his thesis 'Utilizing organic waste biochar to remediate contaminated water and soil'.

Mr Khan's scholarship was supported by Pakistan Higher Education Commission (HEC), with which UWA has an ongoing agreement for capacity building

Anionic (negatively charged ions) contaminants such as arsenic, antimony, chromium, and fluoride are increasing in the environment due to anthropogenic activities like agricultural runoff, fossil fuel combustion and atmospheric deposition.

Mr Khan said organic waste was a significant environmental hazard around the world, with no single solution to address it.

"These anionic contaminants are very difficult to remove from the environment," he said.

"Organic waste could be a valuable resource of char material, which could be used as adsorbent of contaminants in water and as an additive/ameliorant in contaminated soil.

"However, performance of conventional char depends on production conditions and the contaminant type."

At UWA's Crawley campus, Mr Khan conducted sorption experiments to test the efficiency of conventional and engineered char materials as adsorbents on water contaminated with anionic pollutants.

The best performing char materials were then applied to soil contaminated with arsenic, antimony, chromium, and fluoride to assess their performance in soil.

For this purpose, Mr Khan then completed soil incubation, greenhouse, and plant uptake experiments.

"Thankfully, the chars were very successful for the anionic treatment from both water and soil," he said.

With guidance from his PhD supervisors from Pakistan and UWA Professors, Mr Khan has published three research articles in high impact journals.

"Established and well-renowned scientists like Professor Nanthi Bolan, Hackett Professor Kadambot Siddique and Dr Zakaria Solaiman guided me a lot," he said.

"I found all the UWA professors, staff, administration very caring, respectful, and loving to me.

"So, wherever I go in any part of the world, I will be an ambassador for UWA."

Basit Ahmed Khan

basitahmedkhan92@gmail.com

Awards and industry recognition

Name	Award
H/Prof Kadambot Siddique	The Australian's 2022 Research Magazine 'Top Researcher' in Botany
H/Prof Kadambot Siddique	2022 Clarivate Highly Cited Researcher (Agricultural Sciences and Plant & Animal Science)
E/Prof Hans Lambers	2022 Clarivate Highly Cited Researcher (Agricultural Sciences and Plant & Animal Science)
Prof Nanthi Bolan	2022 Clarivate Highly Cited Researcher (Ecology)
Prof Dave Edwards	2022 Clarivate Highly Cited Researcher (Plant and Animal Science)
Prof Jacqueline Batley	2022 Clarivate Highly Cited Researcher (Cross-Field)
Prof Ryan Lister	2022 Clarivate Highly Cited Researcher (Cross-Field)
Prof Zed Rengel	2022 Clarivate Highly Cited Researcher (Cross-Field)
Ad/Prof Jairo Palta	Gold Cross Medal from the City of Cali, Colombia
Assoc/Prof Sally Thompson	School of Engineering 2022 Mid-Career Research Award
Dr Bede Mickan	UWA School of Agriculture and Environment 2022 Outstanding Contributions to Student Learning
Dr Joanna Melonek	Vice-Chancellor's Award for Research Impact and Innovation
Prof Ian Small	Vice-Chancellor's Award for Research Impact and Innovation
Prof Peter Batt	Honorary member of the International Society of Horticultural Science
Riley Faulds	2023 WA Rhodes Scholar

Visitors to IOA

Name of visitor/s	Visitor's organisation and country	Host details	Date of visit
Zhengfei Nie	Lanzhou University, China	H/Prof Kadambot Siddique Dr Jiayin Pang	December 2022 – December 2023
Minhui Bi	Lanzhou University, China	H/Prof Kadambot Siddique Dr Jiayin Pang	December 2022 – December 2023
Dr Muhammad Islam	National Fertilizer Development Centre, Government of Pakistan, Islamabad	H/Prof Kadambot Siddique Dr Jiayin Pang	15 November 2022 – 31 July 2023
Prof Qingping Hu	Shanxi Normal University, China	H/Prof Kadambot Siddique Dr Jiayin Pang	December 2022 – December 2023
Prof Xiangling Fang	Lanzhou University, China	H/Prof Kadambot Siddique Dr Jiayin Pang	December 2022 – December 2023
Delegation from the University of Mataram (UNRAM), led by: Professor Bambang Hari Kusumo, Rector Dr Yusron Saadi, Vice Rector for Planning, Collaboration and Information System	University of Mataram, Indonesia	The UWA Institute of Agriculture and UWA School of Agriculture and Environment	Wednesday 23 November
Dr Karen Tanzo-Barroga Gio Anton Barroga	FutureRice Farm, the Philippines	UWA VC Prof Amit Chakma	Tuesday 15 November
Dr Clare Mukankusi, CIAT- International Center for Tropical Agriculture Winny Amongi, Alliance of Bioversity, Uganda	Uganda, East Africa	Prof Wallace Cowling	Wednesday 19 October
Science and Technology Minister Cai Jianing, Embassy of the People's Republic of China Consul Zao Hongtao, Consulate General Perth	Canberra, Australia Perth, Australia	H/Prof Kadambot Siddique	Thursday 13 October
Ian McClelland	Birchip Cropping Group, Victoria, Australia	The UWA Institute of Agriculture	Tuesday 11 October to Thursday 13 October
Sri Kakani Govardhan Reddy, Hon'ble Minister for Agriculture, Government of Andhra Pradesh	Andhra Pradesh, India	The UWA Institute of Agriculture	Tuesday 11 October
Dr A Vishnuvardhan Reddy, Vice Chancellor Dr G Rama Rao, Registrar Dr K Gurava Reddy, Professor (Agricultural Extension) & Technical Secretary to Vice Chancellor Dr A Mani, Associate Dean, Agricultural Engineering College, Bapatla	Acharya N. G. Ranga Agricultural University, India	The UWA Institute of Agriculture	Tuesday 11 October
Paula Ganly, Australian Ambassador to Iraq	Canberra, Australia	H/Prof Kadambot Siddique	Tuesday 11 October
Azelie Pétrowick	L'Institut Agro, Rennes, France	Assoc/Prof Dominique Blache	Friday 2 September

Research grants

Title	Funding body	Investigator/s
Australian Research Council Centre of Excellence in Plants for Space	Australian Government	Prof Harvey Millar Prof Ryan Lister Prof Ian Small University of Adelaide leads 38 partner organisations
Novel agronomic practices to achieve productive and profitable viticulture in northern Australia	Cooperative Research Centre for Developing Northern Australia	Assoc/Prof Michael Considine

New postgraduate (PhD) research students

Student name	Topic	School	Supervisor(s)	Funding body
Joanne D. Caguiat	Syntenic characterization and validation of drought tolerance genes in rice, wheat, barley, and maize crops	UWA School of Agriculture and Environment	Dr Guijun Yan Dr Hui Liu	Department of Science and Technology - Science Education Institute (DOST-SEI) Foreign Graduate Scholarship Philippine Rice Research Institute
Xavier Caguiat	Genetic and molecular dissection of glyphosate tolerance in wheat (<i>Triticum aestivum</i> L.)	UWA School of Agriculture and Environment	Dr Guijun Yan Dr Hui Liu	Department of Science and Technology-Science Education Institute (Philippines) Global Innovation Linkage (GIL53853) from the Australian Government
Yan Ai	How and why glyphosate, and atrazine application affect White Leaf Spot (<i>Neopseudocercospora capsellae</i>) epidemics, on herbicide resistant canola	UWA School of Agriculture and Environment	Prof Martin Barbetti Prof Guijun Yan Dr Ming Pei You	Self-funded
Nuraizat Abidin	Understanding the interaction of Turnip Mosaic Virus (TUMV) with blackleg disease (<i>Leptosphaeria maculans</i>) in canola	UWA School of Agriculture and Environment	Prof Martin Barbetti Dr Roger Jones Dr Ming Pei You	Brunei Darussalam Government Sponsorship University Postgraduate Award
Garima	Farm to Port: An Optimisation Model to Navigate Through Heterogenous Agents' Interactions in Agri-food Supply Chains	UWA Business School	Assoc Prof Doina Olaru H/Prof Kadambot Siddique	UWA Scholarship for International Research Fees University Postgraduate Award

New IOA appointment

Name	Title	Start date
Dr Shiv Bolan	Research Fellow, The UWA Institute of Agriculture	Thursday 15 September

UWA IOA 2022 Publications

Peer Reviewed Journals

September to December 2022

Abbas G, Rehman S, Siddiqui MH, Ali HM, Farooq MA and Chen Y (2022). Potassium and Humic Acid Synergistically Increase Salt Tolerance and Nutrient Uptake in Contrasting Wheat Genotypes through Ionic Homeostasis and Activation of Antioxidant Enzymes. *Plants* **11**(3): 263 doi: 10.3390/plants11030263

Abideen Z, Cardinale M, Zulfiqar F, Koyro H-W, Rasool SG, Hessini K, Darbali W, Zhao F and Siddique KHM (2022). Seed Endophyte bacteria enhance drought stress tolerance in *Hordeum vulgare* by regulating, physiological characteristics, antioxidants and minerals uptake. *Frontiers in Plant Science* **13**: 980046 doi: 10.3389/fpls.2022.980046

Ahmad B, Dar TA, Khan MMA, Ahmad A, Rinklebe J, Chen Y and Ahmad P (2022). Oligochitosan fortifies antioxidative and photosynthetic metabolism and enhances secondary metabolite accumulation in arsenic-stressed peppermint. *Frontiers in Plant Science* **13** doi: 10.3389/fpls.2022.987746

Ahmad HM, Fiaz S, Hafeez S, Zahra S, Shah AN, Gul B, Aziz O, Rahman MU, Fakhar A, Rafique M, Chen Y, Yang SH and Wang X (2022). Plant growth promoting rhizobacteria eliminate the effect of drought stress in plants: A review. *Frontiers in Plant Science* **13**: 875774 doi: 10.3389/fpls.2022.875774

Alagöz SM, Zahra N, Kamrani, MH, Lajayer BA, Nobaharan K, Astatkie T, Siddique KHM and Farooq M (2022). Role of Root Hydraulics in Plant Drought Tolerance. *Journal of Plant Growth Regulation* doi:10.1007/s00344-022-10807-x

Aleamotua M, Baker JK, McCurdy DW and Collings DA (2022). Phi thickenings in Brassica oleracea roots are induced by osmotic stress and mechanical effects, both involving jasmonic acid. *Journal of Experimental Botany* **73**(3): 756-769 doi: 10.1093/jxb/erab468

Al-lami HFD, You MP and Barbetti MJ (2022). Novel resistances provide new avenues to manage *Alternaria* leaf spot (*Alternaria brassicae*) in canola (*Brassica napus*), mustard (*B. juncea*) and other Brassicaceae crops. *Plant Disease* doi: 10.1094/PDIS-05-22-1153-RE

AlMulla A, Dahlawi S, Randhawa M, Zaman Q, Chen Y and Faraj T (2022). Toxic metals and metalloids in Hassawi brown rice: Fate during cooking and associated health risks. *International Journal of Environmental Research and Public Health* **19** doi: 10.3390/ijerph191912125

Andrews M and Raven JA (2022). Root or shoot nitrate assimilation in terrestrial vascular plants – does it matter?. *Plant & Soil* **476** 31–62 doi: 10.1007/s11104-021-05164-9

Anwar O, Keating A, Cardell-Oliver R, Datta A and Putrino G (2022). Design and development of low-power, long-range data acquisition system for beehives – BeeDAS. *Computers and Electronics in Agriculture* **201** doi: 10.1016/j.compag.2022.107281

Ashraf M and Munns R (2022). Evolution of Approaches to Increase the Salt Tolerance of Crops. *Critical Reviews in Plant Sciences* **41** 128–160 doi: 10.1080/07352689.2022.2065136

Aslam MM, Pueyo JJ, Pang J, Yang J, Chen W, Chen H, Waseem M, Li Y, Zhang J and Xu W (2022). Root acid phosphatases and rhizobacteria synergistically enhance white lupin and rice phosphorus acquisition. *Plant Physiology* **190**(4): 2449–2465. doi: 10.1093/plphys/kiac418

Barmukh R, Roorkiwal M, Dixit GP, Bajaj P, Kholova J, Smith MR, Chitkineni A, Bharadwaj C, Sreeman MS, Rathore A, Tripathi S, Yasin M, Vijayakumar AG, Sagurthi SR, Siddique KHM and Varshney RK (2022). Characterization of 'QTL-hotspot' introgression lines reveals physiological mechanisms and candidate genes associated with drought adaptation in chickpea. *Journal of Experimental Botany* **73**(22): 7255–7272. doi:10.1093/jxb/erac348

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UPCOMING EVENTS

Mike Carroll Travelling Fellowship Presentation

Thursday, 9 February 2023
The University Club of WA

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Editor: Rosanna Candler
rosanna.candler@uwa.edu.au
The UWA Institute of Agriculture
+61 8 6488 4717 | ioa.uwa.edu.au
The University of Western Australia M082
Perth WA 6009 Australia

The UWA Institute of Agriculture acknowledges the contribution of The FA Hadley Bequest and The WE Rischbieth Bequest for support towards communications activities.