Sydney Institute of Agriculture

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THE UNIVERSITY OF SYDNEY

An online newsletter for those interested in academic aspects of the Agriculture sector

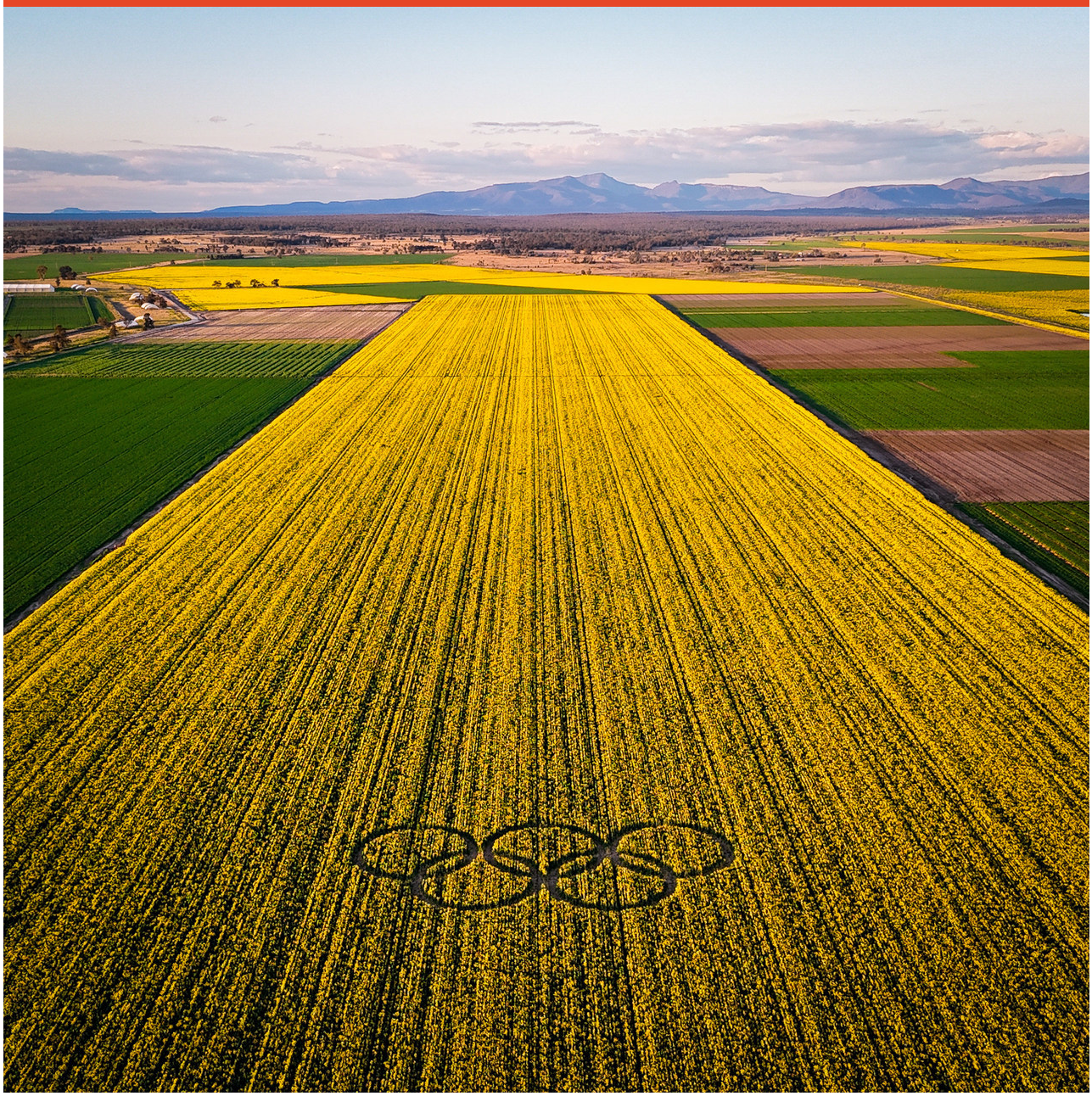


Image credit: Kieran Shephard, Narrabri

Edition 13, August 2024

Events

Annual Narrabri Field Day

Register

Please join us at the I.A. Watson Grains Research Centre for our Annual Narrabri Field Day, meet our researchers and see our research projects. Our theme this year is 'Partnering for Impact'.

- Complimentary BBQ lunch 12-1pm
- Plenary panel discussion – 1-2pm ESG – Environmental, Social and Governance Reporting for Agriculture. Opportunities and pitfalls for farmers.
- Opening the new University of Sydney node of the Australian Plant Phenomics Network. Our new node, based in Narrabri, will provide plant and agricultural scientists access to cutting edge field-based plant phenotyping infrastructure, mobile phenotyping services and FAIR data support.
- Field displays of crop research including; integration of new digital technologies, wheat genetics to support growers,building pulses for protein, building future cropping systems, building a future for commercial wheat breeding.
- Networking drinks in the field.

Register to attend Narrabri Field Day

Research Showcase - Sustainable Food Systems

View the recording of our Research Showcase on Sustainable Food Systems which was held in July.

Theme Leader Updates

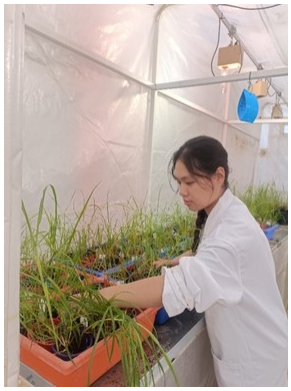
Plant Breeding and Production

Richard Trethowan

Unlocking the potential of kikuyu grasses for the dairy industry

Kikuyu grass is a fast-growing pasture species that produces high quality biomass for the dairy industry. The University of Sydney in collaboration with Hatton's Turf Research has developed a range of new genetically distinct kikuyu lines with greater biomass production and better digestibility

than those released previously. A research project, supported by DairyUP, that aims to confirm the adaptability of these new materials across NSW has been running for the past 2 years with promising results.



Vivien Tan screening kikuyu for disease resistance in the microclimates at PBI

Strip trials at Berry near Nowra after mowing

Many of the materials were developed to not only have greater biomass, but also improved disease resistance and better adaptability to saline soils and drought. The initial trials were conducted using replicated small field plots at Camden. Following intensive evaluation of biomass production, rate of biomass accumulation and nutritional value, a subset of three lines with potential for release to farmers were identified for wider testing in larger strip plots across NSW. These trials have been established at Bega, Nowra and Camden (see photo above) and will be extended to the Hunter Valley in the near future. PhD student, Vivien Tan, is also helping to better understand the causes of kikuyu toxicity in cattle. This sometimes occurs when cattle feed on new growth following a period of drought. She is examining all possible causes including diseases, physiological factors and differences among kikuyu lines in their expression. Vivien's work is starting to produce exciting results that may, in future, provide answers to this intractable problem.

Read further about Plant Breeding and Production

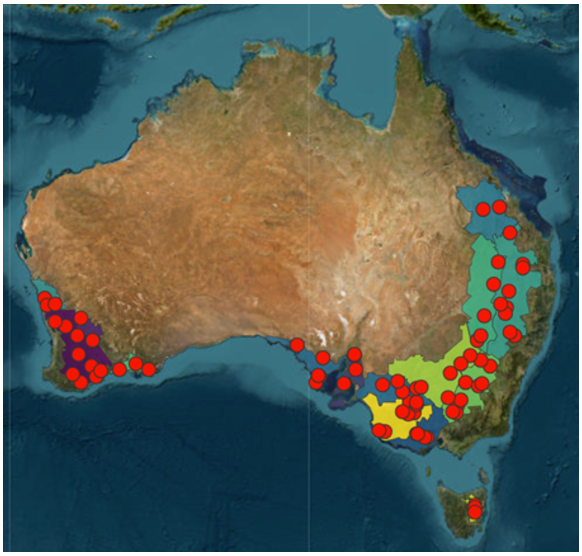
Digital Agriculture

Tom Bishop

In this update I want to focus on one project which is ~$2.7 million funded by the GRDC and is a collaboration between the University of Sydney and Precision Cropping Technologies (PCT) AgCloud. The project team is myself, Patrick Filippi, Jie Wang and Nikolas Hoskins. It builds on a previous GRDC-funded machine learning pilot study on mapping soil led by the recently retired Brett Whelan which developed a novel way to predict soil in 3D soil. In soil science we may sample on horizons or at fixed depths but then wish to map the profile average or at a particular depth such as 0-30 cm for soil carbon accounting. This is problematic if we have sampled at 0-10 cm and 10-40 cm for example, which is not the desired depth we need for our maps. Typically we pre-process the data before modelling. Our approach (Wang et al., 2024) allows the data to be modelled at the native

spatial support and predict at any spatial support, both vertically and horizontally.

While this is an elegant solution, the appeal to the industry is that with the ability to predict at any depth it opens up the possibility to predict the depth to a soil constraint such as sodicity which can lead to actionable information for growers in terms of soil amelioration or adjustment of their bucket size and potential yields. To this end the project involves deploying this approach on PCT's platform to widen its use, but also further testing this approach on 75 farms across Australia (Figure 1) which has involved sampling at 25 locations at 4 depths on each farm, meaning 7500 soil samples are being processed at the University of Sydney soil laboratories. These are being fully characterised for organic carbon, nutrients, cations, EC, pH and for a subset where relevant, region-specific constraints such as boron. There is also an associated budget to collect 20,000 hectares of gamma radiometrics and electromagnetic induction (EMI) survey data to improve the soil maps.



75 farms sampled across Australia overlaying the grain growing regions of Australia

All of the lab work is expected to be finished by September this year. The modelling results will reveal many interesting insights, a few being:
* under which soil types and landscapes do covariates such as EMI and gamma radiometry work best, and where we would recommend their collection by growers?
* more generally, under which soil types and landscapes do our models work?
* what are the sample size requirements for different soil types and landscapes?

The answers to the above questions will of course depend on the soil property being mapped. We are hoping that answers to these questions will deepen the connection between Pedology and Digital Soil Mapping.

The project is a continuation of three decades of soil survey and mapping at the University of Sydney which started under the leadership of Alex McBratney in the 1990s with extensive surveys of all the cotton regions in northern NSW and southern QLD. This has continued over the years and we now have a very large soil archive which is reaching capacity in terms of storage. It is perhaps under-appreciated by the university in terms of the support it receives.

There are many positive impacts of having this archive which are not foreseeable at the time of soil collection. Rothamsted Research where I used to work many years ago is a good example of the unintended positive benefits of a long term archive. If you are interested you can see here.

Already, an unintended benefit of having soil from 75 farms across Australia is that we are now collaborating with NSW DPI and Southern Cross University on a GRDC-funded project related to residual herbicides in soil. An important part of this is physical access to the archived soil data from the 75 farms but also the connection with the growers we have due to sampling their farms.

I encourage all of us to think collectively about the archiving of physical samples for scientists of today and into the future. You never know why or who will need them in the future. The who could even be yourself.

Wang, J., Filippi, P., Haan, S., Pozza, L., Whelan, B., & Bishop, T. F. (2024). Gaussian process regression for three-dimensional soil mapping over multiple spatial supports. Geoderma, 446, 116899. 10.1016/j.geoderma.2024.116899.

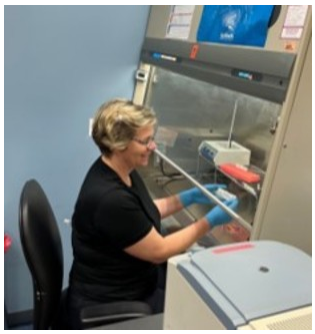
Read further about Digital Agriculture

Animal Agriculture

Joy Becker

Protecting Australia's aquaculture and fisheries industries from exotic viruses

Joy Becker's research program is focused on understanding and controlling production-limiting diseases affecting global aquaculture. Of significance to Australia's aquaculture and fisheries industries is a group of viruses known collectively as Infectious spleen and kidney virus (ISKNV). ISKNV is a serious biosecurity threat to Australia's fisheries and aquaculture industries as well as cultural and recreational fishing practices. Key fish species under threat include barramundi, Murray cod, grouper, Australian bass, Macquarie perch and several species of marine tropical fish (e.g. clown fish). The challenge with these viruses is that they cause similar histopathology, have an extensive and overlapping host and environmental range and cause disease and high mortality in farmed, wild and pet fish. In Australia, this group of exotic viruses is listed as a national notifiable disease and on the national priority list of exotic environmental pests, weeds, and diseases. Detections of ISKNV are notifiable to the World Organization for Animal Health (WOAH).



Joy Becker

ISKNV causes disease in tilapia (pictured) with mass mortalities recorded at many farms in developing economies (such as Brazil, Thailand and Ghana). Tilapia are a key sustainable protein source in many developing and developed countries due to their fast growth rates, and budget friendly prices.

The Florida ornamental pet fish industry has farm gate sales of $172 MUSD per annum. Here is an exemplar shed at a farm. Typically, farms will have several dozen sheds of this size forbroodstock, hatcheries and grow out areas, plus packing and shipping sheds.

Read further about Animal Agriculture

Urban Agriculture

Floris Van Ogtrop

Welcome to the August edition of the Urban Ag theme report. I'd like to start by acknowledging the Gadigal and Wangal peoples of the Eora nation on the lands of which I have written this report and I pay my respect to Elders, past, present and emerging.

Planning ahead, November is the month of urban agriculture. I'd be interested to know if any of our readers would be keen to host one or more events this November that we could advertise through the Urban Agriculture Month forum, these include but are not limited to:

- Hosting a meal using local produce
- Organising a forum with local (or national) experts
- Holding a workshop (composting, keeping chickens, growing food)
- Organising a local community food swap
- Hosting an online Q&A, interview or workshop
- Lead a community garden fundraising event
- Hosting an open day

See https://urbanagriculturemonth.org.au/ for more information.

For other Urban Ag events please check the following:
Sydney City farm
Pocket City Farms
Permaculture Sydney South

Following from this, I'd like to share with you research being conducted by two of our SIA researchers. David Guest is detecting plant pathogens using sniffer dogs. Incredible how sensitive dogs' sense of smell can identify volatiles given off by a specific plant pathogen at low concentrations in the soil. This could be a game changer in identifying potential pathogens that exist in urban forests and urban farms. A dog's nose knows… Oscar Wang, is taking the circular economy to the next level by converting food waste into plant nutrients for vertical hydroponic systems. Next, he could be off to Mars … Oscar's research will be complemented by a new honours student who will be looking at processing waste using soldier fly larvae and then using the leachate in hydroponic systems. They will also be exploring whether nitrogen can be boosted by adding fast activating dehydrated nitrifying bacteria.

Sniffing Phytophthora

David Guest

A recent survey by the PlantClinic at the Botanic Gardens of Sydney of the nurseries that supply seedlings for urban bushland and street plantings in Sydney found that up to one third of the nurseries are infected with species of the dieback-causing plant pathogen, Phytophthora. Phytophthora in plant nurseries causes significant direct losses from seedling deaths and indirect impacts resulting from the distribution of infected planting materials for orchard, urban and

ornamental plantings, and for environmental rehabilitation projects. Nurseries also become a hotspot for the introduction and distribution of new pathogens.

Dieback caused by Phytophthora cinnamomi is a Key Threatening Process to Australia's natural ecosystems under State and Commonwealth legislation. The microscopic pathogen survives in soil and water, infects plant roots and causes plant death, particularly in dry sclerophyll forests growing in winter dominant rainfall areas along the southeast and southwest coasts of Australia. Understorey plant communities are particularly vulnerable, and their loss causes severe habitat damage, impacts on dependent fauna and exposure of bare soil to erosion (Figure 1). Recent discoveries have revealed that multiple species of Phytophthora compound the threat to Gondwana ecosystems, including iconic species such as the Wollemi and Bunya pines.

Ensuring seedlings are pathogen-free is essential to the protection of urban plantings and forests. Disease free nursery accreditation schemes depend on sensitive and accurate diagnosis of pathogens. For Phytophthora this usually requires baiting and identification based on morphology or molecular diagnostics, adding significantly to the cost of nursery production. Sniffer dogs are widely used in biosecurity programs to detect pests and weeds, and trials in California and New Zealand have shown their potential to be trained to detect volatiles indicating the presence of Phytophthora.

With funding from the NSW Government Saving our Species we have collaborated in a pilot trial with NSW-NPWS, Tate Animals and the Royal Botanic Gardens of Sydney, to evaluate the potential of sniffer dogs to detect Phytophthora cinnamomi in nursery and field samples. We showed that sniffer dogs could be trained to detect the pathogen, and that they could distinguish Phytophthora from other pathogens and from other Phytophthora species. They are very sensitive and can detect dilutions of more than 1:100,000 (i.e. less than 10 mg of Phytophthora-colonised millet seed in 1 kg potting mix), in soil samples collected from infected bushland, and in mud attached to vehicles. Our results support their use as a primary screen of nurseries, followed up by conventional diagnostics of suspect samples to reduce sampling costs.

We were recently awarded a federal "Saving Native Species Game changer" grant to extend and expand the research to Western Australia, Tasmania and South Australia over the next two years. Sniffer dogs not only offer an opportunity to improve the detection and management of Phytophthora pathogens in nurseries and reduce further environmental and economic impacts, but their magnetic personalities are a powerful tool for raising public awareness and education.

Figure 1. Dieback caused by P. cinnamomi at Middle Head, Sydney

Figure 2. Echo (L) and Alice (R) with their trainers Avery Keller and Ryan Tate

Recycling Nutrients

Oscar Wang, PhD Candidate

Background

Vertical hydroponics, a method of growing plants in nutrient-rich water without soil under artificial lights, currently faces sustainability challenges. Other than energy use, a key challenge is the reliance on finite nutrient sources such as mined minerals and ammonia-based compounds poses a significant issue. Research into organically sourced hydroponic nutrients is still in its infancy, and current studies highlight the main challenge as yield loss due to salinity-nutrient imbalances.

Research Area

One promising solution is the recycling of urban consumer food waste into hydroponic nutrient sources. This approach offers several benefits:
* Reduction in Food Waste: By converting food waste into nutrients, less waste ends up in landfills.
* Reduced Import Dependence: Cities could become less reliant on imported fresh produce.
* Improved Nutrient Cycling: This method enhances the nutrient cycling within food systems (Circular economy).

Preliminary research into this method has yielded mixed results. Nutrient analysis revealed that both aerobic and anaerobic fermentation processes are odorous and highly acidic, and they do not effectively convert ammonia to nitrates over a 90-day fermentation period. Conversely, "worm wee," or vermicompost leachate, was found to be less odorous and contained sufficient phosphorus (P) and potassium (K). However, it only had about 17.6% of the nitrogen content compared to the control solution.

Yield Trial

In a yield trial using lettuce (Lactuca sativa), the alternative nutrient source resulted in a 25% reduction in yield compared to conventional methods. This indicates that factors other than raw nutrient availability are influencing yield outcomes. Interestingly, organic substrates like used mushroom coir significantly outperformed conventional rockwool substrates in both control and vermi treatments.

Exploring Biologically Active Hydroponic Systems

For sustainable urban horticulture, there may be a need to shift away from sterile culture expectations. Microbes often colonize hydroponic systems, and traditionally, these are eradicated with chemicals and/or UV sterilizers. However, there is potential in developing and facilitating a microbial ecosystem that could:

* Fix Organic Nutrients: Fix nitrogen and/or convert organic matter into plant-available nutrients.
* Inhibit Pests and Diseases: Utilize microbial predation or resource competition to control harmful organisms.
* Improve Crop Yields: Enhance hormonal activity and root development through novel plant-microbe

interactions.

This research points to a future where biologically active hydroponic systems could contribute to more sustainable and resilient urban agriculture practices.

Figure 4. Image showing lettuce seedlings growing in organic grow plugs ready for transplanting intoNFT systems

Figure 5. Image shows 18 replicate Nutrient FlowTechnology Systems at the vertical farm growth facilityat the Australian Technology Park

Read further about Urban Agriculture

Quality Food

Tom Roberts

My colleague Dr Ali Khoddami, PhD student Farkhondeh (Fran) Abedi and I participated in the annual convention for the Australian Institute for Food Science and Technology (AIFST) at the International Convention Centre (ICC) in Sydney on 6-7 August 2024. Fran presented a poster (online) entitled 'Properties of Australian Native Grains for Healthy Whole-Grain Foods' based partially on her publication in 2023 and partially on her more recent biochemical analysis of the grains of the same four species.

The plenary speakers at the conference came from government departments, universities, CSIRO, and the Food and Beverage Accelerator (FaBA). One plenary speaker was Anna Drake, who completed a Bachelor of Food & Agribusiness (Hons 1) at USyd in 2020. Anna is a Sustainability Analyst at Rabobank and gave an excellent talk entitled 'Clearing the air: finding food and agriculture's path in a climate-focussed world'.

Other recent USyd Food & Agribusiness graduates at the congress included Emma Jane Loong, who works as an R&D Laboratory Assistant at Newly Weds Foods Asia Pacific, and Alexia Karatasas, who works as a Quality Assurance Officer for N&A Group, a family-owned grower, packer and marketer of premium Australian fresh produce. It was great to see many current students in the Food Science Major at USyd conducting volunteer work at the congress.

The themes of the parallel sessions included 'Sensory and consumer science', 'Advanced food

manufacturing', 'Allergen bureau', 'Sustainability and the circular economy', 'AI in food manufacturing', 'Food policy and regulation', and 'Food safety systems'. There were many engaging industry stalls, wonderful views of the Sydney CBD, and an excellent food and wine networking event.

There was a range of people from large and small companies, government departments and universities at the congress. I thoroughly recommend the AIFST annual congresses for anyone interested in the science, regulation, and future of food.

Anna Drake (Rabobank) and Hayden Pohio (Freemen Nutra Group)

Read further about Quality Food

Carbon, Water and Soil

Federico Maggi

Some weeks ago, at the end of June, I was invited to participate to the Villars Symposium organized by the Villars Institute, a Swiss-based foundation established only recently, but with an important endowment to support the transition toward a net zero and nature positive economy within the overall framework of planetary boundary science. The event was truly immersive and fully focused on knowledge translation from fundamentally science-based academic discoveries to multiple and diverse stakeholders and, at the same time, also in a friendly environment targeting sustainability and planetary justice.

Certainly, one of the things I liked the most was the settings. We met in the Swiss Alps, in Villars-sur-Ollon, and the place was truly beautiful, just "unique" - like the sticker says. Fortunately, this reminder was on every window of the little train up the mountains, because we could otherwise miss out how unique the sightseing was. Besides, the colleagues I met at the event were just extraordinary, all motivated researchers, positively minded, and absolutely well grounded in the context of sustainability from and across several disciplines, including biology, economy, engineering, agriculture and social sciences.

One of the days I liked the most was the symposium we had with mid school students. Students were from an international network across the Americas, Africa and Asia. The symposium with the

students consisted of a series of workshops where they had to practically solve a true, daily life problem using sustainability principles. I was amazed by how intelligent those students were, and how much they knew about sustainability. We had lunch with the students, and that was even more impressing in the way they were so engaged with science and how many questions they had for us even in front of a great meal! In brief, it was fantastic!

Congratulations to Budiman Minasny, Fellow of the Australian Academy of Science

Budiman Minasny, for all of us Budi, was recently elected Fellow of the Australian Academy of Science. Budi was the earlier Lead of the Carbon, Water and Soil Theme within SIA. Listing all of his awards, grants, prizes and achievements is quite an impossible mission, so he may excuse me if I only provide a very brief summary of his work.

Budi is a soil scientist, and he has devoted a large part of his career in developing theories and applications of digital soil mapping and modelling techniques. His work has provided fundamental new knowledge needed to protect and enhance soil carbon stocks and to sustain agriculture and ecosystems not only at local scales, but worldwide. His foundational contributions include cost-effective digital techniques that can accurately identify where and how soil organic carbon has been depleted or accumulated, locally and at scales, providing the accurate benchmarking urgently needed to model future soil carbon sequestration trends under various land management and climate scenarios. Budi's work has been influential and has been adopted in many organisations in Australia as well as abroad, including the Food and Agriculture Organisation. Budi's research underpins numerous critical 'real world' applications from soil carbon benchmarking to a global movement to increase soil carbon (the 4-per-1000 initiative), established during the Paris COP21 talks. Congratulations again, Budi!

New degree in Environmental Engineering

The Faculty of Engineering is launching the new degree in Environmental Engineering from 2025. This is a new addition to the existing degrees, and one that is very welcome especially in view of the global challenges we are all facing in relation to environmental issues, be these climate change, droughts and extreme precipitations, global warming, biodiversity conservation, and sustainability. I think this is also well situated for education and research interactions with SIA, with the Net Zero Initiative of the University of Sydney, and with the emerging Multidisciplinary Initiative (MDI) in Agrifood Systems that SIA is leading. I look forward to see the new cohort of students enrolled in the degree and possibly contribute to their curriculum and academic education.

Read further about Carbon, Water and Food

Development Agriculture

Daniel Tan

The University of Sydney launched the **Sydney Vietnam Institute** (SVI) in Ho Chi Minh City (Saigon) and Hanoi on 18 and 20 June 2024. The Sydney Vietnam Engagement Booklet is available for download.

Biosecurity and Welfare – Smallholder pigs in Northern Vietnam

Jenny-Ann Toribio

Pork remains the most widely consumed meat in Vietnam with 80% produced by smallholder and semi-industrial farms. In the rural provinces of northern Vietnam raising pigs is an important source of household income. With a growing market for indigenous pork products among urban consumers who have increasing awareness of food safety and animal welfare, improving the health and welfare of indigenous pigs is an avenue to strengthen the marketability of their pork and strengthen the livelihoods of rural families.

Jenny-Ann Toribio spent two weeks in June as a visiting scientist with the International Livestock Research Institute (ILRI) and National Institute of Animal Science (NIAS) to advance investigation of the welfare of smallholder pig in Hoa Binh province. This is a collaboration with Le Thi Thanh Huyen, a leading researcher of indigenous pig systems in northern Vietnam, and with ILRI's Fred Unger and Sinh Dang, who investigate interventions to improve pork safety in Vietnam.

Discussions at NIAS, the top animal science institute in Vietnam attracting national and international funding, identified research opportunities for other USyd researchers in ruminant GHG emission and in conservation and genetics for endangered indigenous pig breeds.

Coinciding with Jenny-Ann completing an Invited Expert review of a new biosecurity assessment survey for backyard/smallholder pig production for Biocheck.UGent (an internationally recognised, risk-based scoring system to evaluate the quality of on-farm biosecurity) reinforced commitment to explore avenues to extend collaboration in Vietnam.

SafePORK

SafePORK is funded by ACIAR and led by the International Livestock Research Institute (ILRI) in collaboration with the University of Sydney (led by Jenny-Ann Toribio), Hanoi University of Public Health, the Vietnam National University of Agriculture and Vietnam's National Institute of Animal Science. With more than 80% of pork produced by smallholder farmers, slaughtered in small abattoirs and sold in wet markets, ensuring food safety practices is key to improving Vietnam's food safety record. In abattoirs, this project has been testing the use of ozonized water, which is a strong disinfectant, tailored inox grids that raise the pork off the floor and the application of good hygiene practices to reduce contamination of carcasses. Interventions at the retail level include using cutting boards, wearing clean aprons and washing meat surfaces and vendors' hands often.

Read further about Development Agriculture

Social Media

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