# The Crawford Fund
## Student Awards

## Reports from their experiences

2021

**Crawford Fund** FOR A FOOD SECURE WORLD

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**Nicholas Metherall, ANU**
**Location:** Fiji
**Research:** Measurement, reporting and verification of agricultural landscapes
using GIS and remote sensing
**Collaborating Institutions:** University of the South Pacific

### Monitoring river landscapes and floodplains in the Pacific ([web link](web link))

Nicholas Metherall, from the Australian National University, who travelled to Fiji as part of his Student Award research to use Geographic Information System (GIS) and remote sensing to measure, report and verify agricultural landscapes.

"The project aims to monitor river environments in agricultural floodplains in the Pacific, and to develop measurement, reporting and verification guidelines for agricultural landscapes to improve farmers' and landholders' access to participation in carbon credit certification processes and carbon market income streams," said Nicholas.

The research aimed to include:

- GIS and remote sensing to map agricultural catchments with landcover and landuse classification.
- Use of carbon accounting modelling software such as Full Carbon Accounting Model (FullCAM) and NatCAP.
- Fieldwork including soil and water quality as well as tree measurement sampling at sites with geotagging to calibrate and validate mapping and modelling.

Participatory mapping was conducted in each village to identify areas of flooding, erosion, streambank collapse, forest clearing, differing agricultural practices and other areas of interest. These areas identified through the participatory mapping at the village level were also used to support further survey work.

"Catchments cannot be studied as discrete or isolated systems. What happens on the land is likely to have significant impacts on waterways, estuaries and coastal oceans. This study seeks to address the risk of this siloed approach through considering interconnected relationships between upstream and downstream ecosystems," he said.

Nicholas' research activities were undertaken across four stages:

1. River water quality sampling
2. Capacity building in forestry inventories
3. Field surveys and forestry inventories
4. Results of geospatial / remote sensing analysis

Capacity building with local research assistants from Fiji was a key component of the research. This involved showing the team how to use the equipment and how and why to measure particular dimensions of trees as part of the riparian vegetation and forestry inventories explained Nicholas.

The surveys included recording species of trees, distribution of trees along the Ba River, as well as the sizes of the trees themselves.

"After completing the capacity-building stages with a number of research assistants and village community members, a series of surveys were conducted across multiple areas of the riparian buffer corridor. The surveys were aided by GIS and remote sensing techniques including generating grids to support randomised sampling across various sites along the Ba River," he said.

Further sites were highlighted including larger forested areas adjacent to areas protected by village communities. These areas were also analysed using GIS and remote sensing including through the use of Digital Elevation Models (DEMs) to build contour maps.

The researchers also looked at the distribution of native and exotic tree species. The findings of the forestry inventory so far have been that the lower floodplain of the agricultural Ba catchment was almost entirely composed of secondary (non-native) forest tree species.

A key part of the study explores the role of riparian vegetation in providing regulating services in agricultural landscapes including:

- Filtering agricultural runoff
- Stabilising stream banks
- Reducing erosion
- Reducing risk of streambank collapse
- Increasing soil infiltration capacity and reducing flood risk

A series of surveys were conducted across multiple areas of the riparian buffer corridor, and these surveys were aided by GIS and remote sensing techniques. These included generating grids to support randomised sampling across various sites along the Ba River and building contour maps.

Boat surveys up and down the Ba River were also undertaken to mark out important sites including areas of different riparian vegetation, land cover change, agricultural practices, erosion and streambank collapse. This included the site of a streambank collapse event in 2012 due to La Nina flooding. The boat surveys also identified areas of gravel extraction along the Ba River which has also impacted water quality.

Flood prone areas were also surveyed and monitored as part of the fieldwork.

"Some preliminary results are captured in Geographic Information Systems (GIS) Software including QGIS and some additional analysis has been done using remote sensing in GIS, Google Earth Engine and Microsoft Planetary Computer," concluded Nicholas.

## NEW SOUTH WALES
### Amy Bates, Graham Centre, Charles Sturt University
**Location/Focus:** Fiji and Samoa
**Research:** Improving small ruminant production and supply
**Other Collaborating Institutions:** ACIAR, Ministry of Agriculture Fiji, Ministry of Agriculture and Fisheries Samoa, the University of the South Pacific, and University of New England



**Improving animal production in Fiji (web story)**

We would like to share the experience of Amy Bates, a PhD Student from Charles Sturt University. Initially, Amy's Student Award project research, focused on small ruminants in Fiji, was to assist in the collection and analysis of data relating to condition score and liveweight (if collected) and pregnancy outcomes, and the relationship between these factors. However, travel delays because of COVID-19, meant that she had to turn her efforts to pregnancy scanning, also a component of her PhD work. She assisted with data collection and trial pregnancy scanning on small holder farms in Fiji and establishing an appropriate pregnancy scanning regime for the project. We really enjoyed Amy contributing to our Insta Campaign providing us with photos when she was over there!

The project is related to ACIAR work (LS/2017/033), improving small ruminant production and supply in Fiji and Samoa. In Fiji, Amy worked with the Pasifika Sheep and Goat Improvement Project.

Small ruminants are an important part of both the day-to-day and ceremonial requirements of Fijian culture. Currently, demand for small ruminants is not being met by the local production and meat is imported to meet demand. Lower quality cuts are often imported due to cost, and the imported meat poses a health risk as it usually has a high fat content.

"Due to the importance of small ruminants to Fijian culture, the Fijian governments is wanting to assist small ruminant producers to improve their production to better meet the demand for small ruminant meat and ensure better quality, leaner cuts of meat are available," said Amy.

Improving the management of small ruminants has the potential to increase production, which is beneficial to both producers through greater production output, and consumers through greater availability of better quality, leaner meat. Non-communicable diseases, such as diabetes and heart disease, are high and of concern for the Fijian government.

Further, ensuring the nutritional needs of small ruminants are met has the potential to improve both conception rates and the number progeny born and weaned.

"Broadly, my PhD research is exploring the condition and liveweight of ewes at mating and how this impacts reproductive potential. This is being explored across breeds and mating seasons. An economic analysis is also being performed to explore the differences between breeds, mating seasons and location. Further, producers are also being surveyed to better understand their management practices and reasons for performing these practices," explained Amy.

The Crawford Fund Student Award allowed Amy to travel to Fiji and stay for four weeks to experience agricultural research in the context of a developing country. The main objectives of Amy's placement were to assist in data collection for the wider project and to determine how a pregnancy scanning regime might fit within the project.

The identification of pregnant and non-pregnant ewes by pregnancy ultrasound scanning allows producers to manage a ewe flock based on the nutritional requirements of the ewes – those with more foetuses having greater nutritional needs compared to those with one or no foetus. This means resources are not misused or wasted, which has economic benefits alongside improved production.

"Prior to visiting Fiji, I spent time with a commercial pregnancy scanner in southern NSW to learn how to identify pregnant and non-pregnant ewes. The equipment used, however, is very different and as such, trialling with the exact equipment was essential. At the time of my visit, many dams were either giving birth, or were heavily pregnant. However, using the project ultrasound device, I attempted to pregnant scan dams," said Amy.

Amy identified several difficulties with the process, including:

- the ultrasound equipment is very different between brands and models, so using the project scanner took some getting used to.
- the animals had much greater hair cover in Fiji compared to Australia and as such, had to be shaved to get a good sound image.
- there is a window in which pregnancy scanning can successfully and reliably be performed, around 70-100 days post conception. The heavily pregnant nature of the dams made foetal detection very difficult. A foetal heartbeat was often detectable, but at this point, pregnancy may be physically observable.

"The use ultrasound pregnancy detection was discussed at length regarding the relevance to the project. Until more dam data is collected within the project, it is unknown when the best time to use ultrasound scanning is, and if it will be a useful practice. Once data has been collected across the year (for an entire 12-month period), the practicality of a pregnancy scanning regime will be able to be determined," said Amy.

While in Fiji, Amy also:

- helped with drenching as a component of the parasite management of the project
- observed and assisted with the Gender Equality and Social Inclusion (GESI) component of the project performed where discussions were held with female producers to better understand the role of female producers in Fiji.
- assisted sample collection for a foot rot project at a government sheep farm with a visiting foot rot specialist from Australia. The level of foot rot across Fiji is unknown, however lameness is a known issue, especially during the wetter months and it is predicted to by a chronic unmanaged issue.

"From a wider perspective, the greatest learning from my work in Fiji was that a lot can be achieved with very little. With very few resources, data can be collected and used to make inference and analysis. This understanding will serve me well as I progress with my research career. Further, understanding how communication, even if in the same language, is nuanced. This was an interesting aspect of working in Fiji. Exposure to this has given me the space to consider how I communicate, and how it may be improved," she said.

"Witnessing the production of sheep in a different climate, country, culture and with limiting resources was beneficial. Differences and commonalities to the sheep production I have been exposed to in Australia were apparent, the most obvious difference being resources and commonality the care producers have for their flocks. For the project, as more data becomes available, the information I was able to share around use and timing of pregnancy scanning will become apparent and applicable," said Amy.

"Exposure to developing agriculture research and extension has stoked the fire to continue on a journey in the developing agriculture space," she concluded.

## Lauren Stoot, Charles Sturt University
**Location/Focus:** Laos
**Research:** Delta Flows: The role that delta's play in sustaining basin-scale fisheries
**Other Collaborating Institutions:** National University of Laos, Research Institute for Aquaculture No 2 Vietnam, Fauna and Flora International and Department of Fisheries Myanmar and Institute for Water Education.



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### Sustaining fisheries in Laos, Myanmar and Vietnam ([web link](web link))

Lauren Stoot from Charles Sturt University who received her Student Award last year for her research on the role that deltas flows play in sustaining basin-scale fisheries.

The project was initially established by Dr Lee Baumgartner and Dr John Conallin from Charles Sturt University, along with various researchers in Laos and Myanmar as well as collaborators at ANU in Canberra. Lauren's Student Award supported her involvement in the project's final data analysis and collation of the results which will be presented at a virtual partner workshop which includes transboundary stakeholders.

The main objective of Laura's work is to improve the basic knowledge of movement patterns for important subsistence migratory fish species in the Mekong and Irrawaddy deltas. This will assist in water allocation planning and hydropower, multipurpose and irrigation infrastructure development decision making.

"We want to link fish ecology to livelihood outcomes for people," said Lauren.

The basins of both the Mekong and Irrawaddy Rivers are complex social-ecological systems providing resources to support large, reliant local populations over three countries – Laos, Myanmar and Vietnam. Migratory fish species are a major resource provided by both rivers and an essential component of food security in delta and upstream areas.

Fisheries are threatened by plans to fragment the rivers with the construction of dams and alter their flows to prioritise energy generation. This fragmentation cuts off critical migration pathways and flow alterations disrupt habitats required for different life stages of key fish species.

Laura's report to the Fund explained that if hard data on fish migration can be obtained now, there is a substantial opportunity to either alter their planning on such dams, and move them away from migratory routes, or at a minimum to ensure they incorporate adequate fish migration facilities. Once the dams are built, it will be too late.

The project had three parts. Firstly, a capacity building workshop was held on delta fisheries in both basins, to gather the current state of knowledge and innovative technologies to use to map migratory pathways. From this, researchers worked together with authorities and communities in the delta regions of both basins to collect information on the most important subsistence, commercial and endangered fish species.

Secondly, using the information gathered, the key species to sample were identified and using innovative technology, known as otolith microchemistry, the key migratory patterns of these fish were mapped. Otoliths, a fish's inner ear bone, are calcium carbonate structures that amass layers of calcium carbonate as the fish ages in "rings" similar to those of a tree. In addition, otoliths also incorporate chemical elements from the water in which they live, as a sort of "chemical passport" of the areas in which they've been. By collecting water samples from throughout the catchment, chemical differences can be identified in both water samples and otoliths and propose habitats that fish are using and movement patterns.

Finally, through another partner workshop this information will then be discussed in relation to informing planning, policy and management, and preliminary guidelines designed.

Preliminary results suggest that most species in the Mekong and Irrawaddy River move between marine, estuarine and freshwater habitats during their lifetime. Some individuals completed multiple trips between marine and freshwater habitats, for activities potentially linked to foraging or spawning. These results, highlight the need for unobstructed passage of large rivers such as the Mekong and Irrawaddy.

Two manuscripts regarding the findings of this project are currently being drafted.

"I'd like to thank the Charles Sturt project team, Dr Lee Baumgartner and Dr John Conallin for providing me with this opportunity. Furthermore, I'd like to thank An Vi Vu for his assistance with sample preparation," said Lauren.

The project also involved collaboration with the National University of Laos, Research Institute for Aquaculture No 2 Vietnam, Fauna and Flora International, the Department of Fisheries Myanmar and the Institute for Water Education.

## Rafaela Barbosa de Andrade Aragao, Griffith University
**Location:** Brazil
**Research:** The role of information in deforestation



**The power of communication to drive sustainable agricultural practices** ([web story](web story))

Rafaela Barbosa de Andrade Aragão, a PhD student at Griffith University, received her Student Award and travelled to Brazil for a project assessing "Communication strategies on sustainable agriculture: The case of soy farmers in the Brazilian Cerrado." Rafaela's project was also supported by the University of Arizona.

"The Crawford Fund Student Award allowed me to conduct a focus group with Brazilian soy farmers in the Tocantins state. The Cerrado biome, where Tocantins is located, is a critical hotspot for biodiversity, but it has been rapidly disappearing due to soy expansion. I focused on the state of Tocantins because it has one of the highest rates of soy deforestation in Brazil," said Rafael.

"The primary focus of my PhD research centres around understanding the viewpoints of farmers in this complex landscape. With the support of this Award, I was able to delve deeper into a critical aspect of conservation interventions: communication. Effective communication is paramount, as any policy or regulation aiming to combat deforestation relies on farmers embracing sustainable practices. The project's objective is to develop communication strategies tailored to farmers' needs, ultimately promoting sustainable food production," she explained.

According to Rafaela, the global pressure to reduce deforestation has intensified over the years, particularly in tropical forests. However, in the Brazilian Cerrado, the most biodiverse savanna in the world, land conversion is occurring at alarming rates. Most of the land conversion in the Cerrado occurs due to soy cultivation and cattle ranching, and much of it is taking place within legal regulatory limits. To curb soy-driven deforestation in Brazil, it is crucial to improve communication on sustainable agriculture with soy farmers, as they play a pivotal role in these land use decisions.

Rafaela facilitated the focus group discussions in person in Portuguese, and all ethical considerations were followed to protect the farmers' identities.

"I conducted a focus group with seven soy farmers from Palmas, the Tocantins' capital, to understand their perspectives on three potential scenarios aimed at curbing soy-driven deforestation," she said.

"The farmers expressed keenness to adopt sustainable practices aligned with their goals of increasing yields and preserving the environment. However, they expressed concerns about biased information, underscoring the importance of relying on trustworthy sources with scientific evidence for effective communication," she said.

"Farmers often encounter challenges in navigating complex and ambiguous regulations, necessitating guidance from agronomists or environmental professionals. Identifying trusted stakeholders and preferred modes of communication is a crucial step in communicating sustainable agriculture," she said.

"For example, in Brazil farmers heavily rely on WhatsApp for communication related to their land-use decision. Policymakers worldwide must understand the most effective communication modes to interact with local farmers. Disseminating sustainability information through channels that farmers rarely access would render conservation efforts ineffective," she said.

"To ensure successful conservation implementation, it is vital to make farmers feel valued and involved in finding solutions. Enforcing regulations from sources they distrust, without considering farmers' beliefs and perspectives, may lead to resistance and negative reactions," she said.

"The research offers valuable insights for Queensland's environmental management, including lessons on regional specificities, fostering collaboration among farmers, preferred communication modes, and the significance of trusted stakeholders," she said.

Between 2019 and 2023, alarming deforestation alerts in Queensland surpassed one million, spanning an area of 13.1 thousand hectares. A significant portion, approximately 85%, of this clearing during 2019-2020 was aimed at creating new pasture areas. Consequently, effective communication of sustainable practices with farmers is relevant to Queensland's environmental preservation and land management efforts.

"The research findings can inform policymakers, the scientific community, and the agricultural industry on communication strategies to promote sustainable agricultural practices. The project website (https://www.comunicagro.com.br/) disseminates the finding of this research," she said.

"I am currently in contact with Brazilian agriculture magazines and associations to disseminate the research findings further and an academic publication on the findings of the focus group is in progress and will encompass a partnership with researchers from Griffith University, the University of Queensland, the University of Arizona, and the Stockholm Environment Institute," she added.

"On a personal level, this experience has been highly impactful for my career in the agriculture sector. Interacting with farmers directly and learning from their experiences has enriched my understanding of environmental management. I believe this field knowledge will be instrumental in securing a job in the industry or government after completing my PhD, allowing me to make meaningful contributions to sustainable agriculture practices," concluded Rafaela.

## Trinh Huynh, University of the Sunshine Coast
**Location:** Vietnam
**Research:** Building an effective forest biosecurity network in SE Asia
**Other Collaborating Institutions:** ACIAR, Forest Science Institute of Central Highlands and South of Central, Vietnam



**Assessing the potential of biochar in Vietnam's forestry industry** (web story)

Ms Trinh Huynh, a PhD student at the Forest Research Institute, University of the Sunshine Coast who received her Student Award in 2021 for a project assessing the production potential of biochar from biomass residues in plantations in Vietnam.

Trinh's research, also supported by the ACIAR project FST/2020/123 "Building an effective forest biosecurity network in SE Asia," aimed to estimate the theoretical potential for biomass residue conversion to biochar by (i) developing allometric equations for estimating the total aboveground biomass of acacia plantations at harvesting age (7 years old) and (ii) estimating the potential of biomass residue for producing biochar.

According to Trinh's report, biochar produced using modern technologies allows the sustainable conversion of biomass residues (unused biomass) into long-term stable biochar which provides a carbon-rich solid product for various applications. Benefits include:

· improved crop yields and reduced fertiliser requirements
· reduced nutrient leaching, increased water holding capacity and soil organic carbon
· improved soil health and enhanced crop productivity, and
· preventing pest and disease outbreaks by creating healthy and resilient plants.

She noted that Vietnam has about 4.4 million hectares of planted forests across eight regions. The Central Highlands has been planted with around 0.46 million hectares owned by smallholders. Currently, forestry residues from logging, such as bark, branches and foliage are mainly used as firewood (bark and branches) or left in the field and burned.

This results in increased release of carbon dioxide into the atmosphere and may contribute to global warming. These biomass residues could instead be used to produce biochar.

"The findings show that collecting forest residues left on the ground of small-scale plantations following harvesting could provide biomass for biochar production, providing income diversification for smallholders, carbon sequestration benefits and potential improvements in tree health," said Trinh.

"The results provide recommendations for researchers, forestry officers, industry, small landowners, farmers and plantation owners on how to use biomass residues effectively and sustainably and importantly, contribute to smallholder incomes."

Conducting this project also led to the first-time collaboration between the Forest Science Institute in the Central Highlands Vietnam and the Forest Research Institute at the University of the Sunshine Coast. Successful delivery of this case study also offers insights into the skills and knowledge needed for future collaborations between Australian and Vietnamese institutions.

"Financial support from the Crawford Fund and the ACIAR project was greatly appreciated. I also warmly thank Mohammad-Reza Ghaffariyan, David Lee, Tom Lewis, Madaline Healey, and Simon Lawson for their supervision and for providing key suggestions for improvement of my proposal and final report," said Trinh.

"I would like to acknowledge support from research collaborators at the Forest Science Institute in the Central Highlands of Vietnam and the Forest Research Institute, University of the Sunshine Coast. Especially, I also would like to thank Nguyen Van Hau, who helped in organising the fieldwork to collect the biomass data. Without help from Hau, I could not finish the data collection due to Covid-19 travel restrictions. Finally, I greatly appreciate the farmers who helped with destructive sampling trees, including Ngan Thi Duyen, Luong Van Ba, Bui Van Duong and Ha Van Hiep," she concluded.

## Yichen Kang, University of Queensland
**Location**/**Focus:** Mexico
**Research:** Designing roots to enhance durum wheat yield
**Other Collaborating Institutions:** CIMMYT, GRDC



**Learning from the Best in Wheat Breeding and Genetics** ([web story](web story))

Yichen Kang from the University of Queensland travelled to the International Maize and Wheat Improvement Center (CIMMYT) in Mexico and stayed for three weeks as part of her Student Award research to design roots to enhance durum wheat yield.

Wheat is one of the most important staple crops and plays a fundamental role in the global food security. To meet expected global demand, wheat production would have to grow by at least 30% before 2050 from current production level. The deployment of new wheat varieties with enhanced resilience presents a vital solution for achieving production goals under sustainable agriculture by reducing the reliance on land and resources.

CIMMYT's breeding network and global partnerships offer great opportunities for the exchange of knowledge and genetic resources and leveraging breeding capacity building.

"The major aim of my trip was to gain a detailed vision of the well-structured planning of wheat pre-breeding practiced at CIMMYT. Within this, another objective was to explore the potential of integrating root traits and new genomic prediction methods in exploiting CIMMYT wheat diverse panels for improving adaptation to heat, drought and favourable conditions," said Yichen.

The last decade witnessed an unprecedented increase in the development of various technologies for speeding up the genetic improvement of major cereal crops. CIMMYT's Global Wheat Program, then led by Australia's Dr Alison Bentley, represents a world-class wheat breeding and germplasm enhancement program. It has capitalised on new technologies that support advances in plant breeding to ensure genetic yield gains and support delivery of improved wheat varieties.

"The CIMMYT wheat breeding team gave me an overview of their stage plan, which incorporates interdisciplinary approaches to facilitate the use of exotic materials or wild relatives for wheat improvement," said Yichen.

"On top of that, they also provided practical insights into the execution of different pre-breeding activities. For example, I was taken to their molecular lab and walked through the procedure of Kompetetive Allele Specific PCR (KASP) assay, an efficient high-throughput genotyping technique that has been routinely applied in marker-assisted selection at CIMMYT," she said.

"The major goal of pre-breeding is to deliver novel sources of traits/alleles/genes in acceptable agronomic backgrounds that can be readily used by breeders in their pipelines. So, an important step in crop pre-breeding is the access to germplasm resources. Through global collaboration and sharing of genetic materials, CIMMYT has established the largest wheat collection in the world for research and pre-breeding, with over 150,000 genotypes from more than 100 countries," explained Yichen.

"This germplasm encompasses a wide range of genetic diversity, including landraces, wild relatives, and elite lines. They were gathered from different agro-ecological zones and environments, making them valuable for introducing genetic variation for climate resilience to well-established cultivars," she said.

"This award offered me an invaluable opportunity to learn from the best in the field of plant breeding and genetics," said Yichen.

Presenting my PhD study in root angle for the genetic improvement of root system architecture at CIMMYT.

"Although tremendous progress has been made in breeding physiological traits, there exists a knowledge gap in the genetic improvement of root systems. CIMMYT has undertaken extensive field experiments in Obregón to characterise root traits of interests in different growing environments. However, the value of those root traits in modifying root system remains to be clarified which limits their integration in wheat variety development," she explained.

"As an important aspect of my PhD research involves linking root component trait and root distribution under field conditions, the developed robust statistical methodologies and analytic framework through this research may provide useful tools for dissecting CIMMYT's root dataset. This presented a good opportunity to share my work in durum wheat roots, which has attracted great attention from the CIMMYT wheat team," she said.

"The biggest benefit from this award is the establishment of my professional and personal partnerships with researchers at CIMMYT. The opportunity to communicate recent research advances achieved at UQ to the CIMMYT community, like root research and novel genomic prediction and selection approaches in plant breeding, allowed me to showcase the ability of UQ to bring plant breeding forward," she said.

"My sincere appreciation extends to the CIMMYT staff and my supervisory team at UQ, especially Prof. Lee Hickey, for supporting me to apply this student award and coordinate this visit for me to the hub of global wheat breeding and research," concluded Yichen.

## Sabrina Morrison, University of Queensland
**Location**/**Focus:** Uruguay
**Research:** Rapid discovery and utilisation of novel disease resistance in barley
**Other Collaborating Institutions:** GRDC, Instituto Nacional de Investigación Agropecuaria



**Breeding net form net blotch resistant barley** (**web link**)

Sabrina Morrison from the University of Queensland ravelled to the National Agricultural Research Institute (INIA) in Uruguay as part of her Student Award research to find resistance traits for net form net blotch (NFNB) in barley.

Net form net blotch (NFNB), caused by the fungal pathogen Pyrenophora teres f. teres, is a disease of barley that causes severe yield losses and reductions in grain quality. P. teres is found in most regions of barley production around the world, including Australia.

Breeding durable resistance into cultivars has become a high priority with the emergence of fungicide-resistant P. teres f. teres populations. Exotic isolates of the pathogen remain an ongoing biosecurity threat to the Australian barley industry.

"The Crawford Fund Student Award allowed me to screen the resistance traits of almost 1000 diverse barley lines against local Uruguayan Net form net blotch NFNB disease," said Sabrina.

"Funding from the Crawford Fund, as well as from the Grains Research and Development Corporation (GRDC), facilitated the planting and maintenance of these barley lines. Barley plants grown in the field were left to become infected by local P. teres f. teres populations in the environment, and my primary role in the project was to screen these barley accessions for NFNB disease," she said.

"Screenings of other diseases of barley (leaf rust, stripe rust, powdery mildew, and bacterial blight) were also conducted as an added component later in the project, with further disease screenings and a genome- wide association study (GWAS) planned too," she said.

"The GWAS analysis will be conducted to compare the disease resistance traits of the barley lines against Australian and Uruguayan pathogen populations. From this, we will be able to identify novel haplotypes that facilitate resistance against NFNB, and potentially other diseases, across both countries," said Sabrina.

Phytopathogens pose an ongoing threat to the Australian barley industry, causing an estimated loss of $252 million in yield every year. Net blotches, caused by the fungal pathogen Pyrenophora teres, contribute to over $125 million of this annual yield loss.

Current management approaches to net blotch diseases include the use of fungicides, resistant barley varieties, crop rotation practices, and stubble management. Fungicide use is the main method for controlling NFNB in Australia, however, fungicide-resistant fungal populations have appeared across the Australian grain belt in recent years.

The development of barley breeding lines that are resilient against NFNB disease is therefore important for sustaining the industry. Breeding for durable resistance against this disease has been challenging due to the pathogen's ability to overcome common resistances in modern cultivars. Therefore, the identification of novel resistance loci and genes is crucial for the development of more robust breeding germplasm explained Sabrina.

Uruguay, located on the south-eastern coast of South America, has a similar latitude and climate to the Australian southern wheatbelt. Barley is the country's second-most important winter crop. Similar to Australia, NFNB is a major pathogen that impacts barley production in Uruguay.

"This project provided me with an invaluable array of skills and new knowledge that I can apply to my future research opportunities. I have gained an in-depth understanding of cereal maturity and grain production. I have also gained new knowledge on plant pathogens and their diseases that I can take with me into my PhD, which is also encompasses work on cereal pathology," said Sabrina.

**Chitpasong Kousonsavath, The Centre for Global Food and Resources, The University of Adelaide**
**Location/Focus:** Laos
**Research:** A comparative study of consumers' organic food purchasing behaviour in Laos and Australia
**Other Collaborating Institutions:** National University of Laos



**Comparing purchasing behaviour for organic food in Laos and Australia (web story)**

Chitpasong Kousonsavath's PhD research focuses on the purchasing behaviour of consumers regarding organic food in Laos and Australia. This project utilises two distinct datasets, respectively covering 1,001 Australian and 272 Lao consumers. While Chitpasong's research involves data collection in Laos and Australia, this report focuses on work conducted in Laos, where the financial support from the Crawford Fund Student Award was utilised.

"The core focus of this project revolves around consumers' knowledge and trust in relation to their purchase intention. Additionally, the study aims to provide a comparative analysis of organic food purchasing behaviour between Australian and Lao consumers," explained Chitpasong.

"The Student Award allowed me to include Laos as an emerging organic food market that was not previously well understood and conducting the field survey in-country provided greater opportunity for me to test different research methodologies and gain further experience in consumer studies."

Chitpasong explained that this research could potentially assist both government and organic food businesses in better understanding the current status of organic food consumption, and to develop more targeted and effective promotional strategies.

In her report she explained sustainable agriculture and organic farming were established in Laos in the late 1990s by Non-Government Organizations (NGOs), and most of their work focused on the production side. During the 2000s, several organic movements were introduced. These included market linkages, and the establishment of an organic certification body under the Ministry of Agriculture and Forestry.

Despite the Lao Government's strong support, Chitpasong found that there is relatively limited knowledge available about organic food consumption behaviour in Laos.

"The growing trend of organic food production in Laos highlights the need for a deeper understanding of related consumption behaviour, which currently remained largely unknown. Therefore, obtaining valuable insights into the demand side of organic food can facilitate the development of effective marketing strategies," she said.

Data collection for Chitpasong's project involved six focus group discussions, and consumer surveys at the major wet and organic food markets around the capital city Vientiane.

The study primarily revealed that, wet markets played a crucial role in household food shopping behaviour of the Lao consumers, with key food items such as rice, meat, fresh fruits and vegetables and fish and seafood were shopped from the wet market.

In addition, participants rated foodborne illness from bacteria and contaminations (42.6%) and the use of pesticide and herbicide (32.4%) as their most important food safety concerns. Participants were asked to express their perceptions over the benefits of food product labelled with the Lao organic logo. Over 70% of respondents perceived that food products labelled with organic logo are a healthier choice, better for the environment, better for human and society, guaranteed to be better quality and free from chemicals. These indicated a more positive perception for foods with organic logo.

The knowledge about organic food was also explored, with participants asked if they have seen or heard about organic food production and what it meant to them. Results showed that, the Lao consumers were relatively well-informed about the meaning of organic food production, with almost 90 per cent correctly answering the survey.

According to Chitpasong there are a number of benefits from her research for this project. Firstly, the project paved her way towards a future career as a consumer behaviour researcher. Secondly, this research has highlighted key drivers and barriers of organic food consumption, which were previously overlooked, and will be able to help governments and organic food businesses better target their potential consumers. Finally, this project has contributed to the extension of the research collaboration between the University of Adelaide and the National University of Laos, which could help shape an upcoming new project on safe, fresh and year-round vegetables in Cambodia and Laos.

### Nicola McGunnigle, University of Adelaide
**Location/Focus:** Nepal
**Research:** Enhancing Livelihoods from Improved Forest Management in Nepal.
**Other Collaborating Institutions:** ACIAR, Forest Action Nepal



**Improving rural livelihoods in Nepal** (web link)

Nicola McGunnigle, a PhD Student from the University of Adelaide, travelled to Nepal to undertake research into How restoring forests for sustainable development of underutilised and abandoned land in middle hills of Nepal might lead to positive impacts for rural livelihoods. The project is related to ACIAR work highlighted in an earlier Crawford Fund journalism award visit to Nepal by ABC TV Landline. We previously presented a taste of Nicola's journey to Nepal when we featured her fantastic words and images on our Instagram platform while she was in the field living the Student Award experience.

"The primary objective of my PhD research is to assess how restoring forests on underutilised and abandoned land in middle hills of Nepal might lead to positive impacts for rural livelihoods," said Nicola.

"In the middle hills of Nepal, up to 30% of cultivatable land has been left barren for a range of socioecological factors, primarily driven by out-migration. A consequence of agricultural land abandonment is the encroachment of forest species. Loss of agricultural land is seen as a threat to food security and livelihoods and these emerging private forests are yet to be fully realised for livelihood or alternative income benefits," she said.

Nicola explained that the purpose of her field research was to assess farmer's perceptions of the tree species that are naturally regenerating on former cultivated land and the potential opportunities from, and barriers to, a sustainable future under forestation. Furthermore, what barriers to a sustainable future from a forested landscape exist from policy measures and conflicting policy objectives?

Getting research underway, Nicola taking notes as she counts trees – asking which species are beneficial to the farmers, which ones are not, and whether invasive species are present (left) and with farmers looking at their integration of cardamom in former cultivated land that has regenerated with forest (right).

Traditionally two thirds of Nepal's population have subsisted on family-owned agricultural holdings. However, in the middle hills, productive cultivation of the land is challenged by the nature of small land holdings on steep slopes, marginal production quality, high costs and low to no profit and logistical difficulties to mechanise. With increasing shortage of labour and adequate irrigation, and an aging population, farmers are also facing increased wildlife conflict as the forest grows ever-closer to crops. The benefits of regeneration can be ascertained by assessing what is important to farmers that have abandoned agricultural land and their perceived constraints around change.

Due to Covid-19 travel restrictions, the first phase of the research project, a socioecological survey, was undertaken using the assistance of Nepali researchers coordinated from Australia.

Three study areas were researched through 100 household surveys in each of Kaski, Tanahun and Gorkha districts in the middle hills of Nepal (a total of 300 surveys). Two thirds (66%) of survey respondents had experienced reforestation on their unused or underutilised agricultural land, with 80% of vegetation described as natural succession.

When travel opportunities re-opened, Nicola travelled to Nepal to follow up survey participants in the field. The field work comprised a mixed methods approach: "talk and walk interviews" to assess farmer's perceived benefits of regenerating species on abandoned agricultural land and to look at what was actually growing on the land.

"The "talk and walk" methodology provided time for farmers to warm up and engage during the data collection. Farmers then took ownership of which land they chose to take us to and participate in interactive data collection. Spending time with the farmers provided a richer understanding of the social context, as well as the sheer challenge of farming on steep, marginal land parcels, and therefore the potential opportunities and barriers around any sustainable production from this land, whether this be agricultural or forest," she said.

"Meeting the farmers in the field also allowed a further opportunity to gauge people's attitudes and feelings around loss of agricultural land and gain of forest that can't be measured on paper. The natural flow of conversation beyond the pre-determined questions also provided a fuller understanding of the context and the ability to ask additional questions. This provided a bigger picture to better understand the complex social and biophysical factors in land abandonment and the relationships between land, income and livelihoods," Nicola said.

Nicola found that the reasons for land abandonment are often compounding. While labour shortage was cited as the most significant reason, this was exacerbated by old age, inadequate water supplies, economic restraints and biophysical limitations of the land in terms of access or mechanisation. With increasing forestation, wildlife is also an increasingly common problem, with agricultural crops near forests destroyed by monkeys, deer and porcupines. Some farmers had deliberately left land uncultivated to allow grass and fodder species regenerate for the purpose of cutting for livestock feed. Other farmers have planted low labour cash crops, such as cardamom, which flourishes in the shade of naturally regenerating native Utis.

In addition to the farmer meetings, interviews were carried out with a few key informants identified from land management and conservation sectors in government and NGOs to assess potential opportunities or barriers to landscape level natural regeneration. Findings from these meetings included:

- There is an overall opinion (both within and outside of government) that there is little coordination between and across sectors in terms of land management.
- Perceptions around future land utilisation of abandoned agricultural lands and sustainability of livelihoods from forest products was not consistent across the individuals interviewed, nor with farmer's experiences.
- There was a consensus that with the local governments now having more authority and resources, that these could form an enabling environment for intervention and support for land- dependent livelihoods.
- Forest was generally viewed as a long-term livelihood investment, which could contribute to food security through alternative income generation and a capacity to purchase food.
- Forests were viewed as synonymous with balanced ecosystems and richer biodiversity, also contributing to land stability, improved water functions and climate change mitigation through carbon sequestration.

"To fulfil the research objective, more research is needed to better understand through farmer's perceptions the potential benefits of species that are regenerating and whether indirect benefits are sufficient for sustainable livelihood outcomes if benefits are not perceived or exploited directly," said Nicola.

"The supervising researchers are currently invested in the University of Adelaide based EnLiFT2 project (https://enliftnepal.org/), in partnership with Forest Action Nepal and supported by ACIAR, to advance silviculture trials to assess the values of improved productivity and income from community and private forests," she explained.

"My additional research on naturally regenerating forests can similarly contribute to practical development of appropriate governance arrangements based on changing forestation and demands for forest products outside of community forests. Research has been undertaken in collaboration with staff at Kathmandu Forestry College, including appointment of field enumerators in Phase 1 and field assistants in Phase 2. The collaboration has built partnership for ongoing research opportunities and has helped develop social and scientific research skills for seven young Nepali science graduates through their experiences in participating," she concluded.

# The Crawford Fund

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