The Crawford Fund
Student Awards

Reports from their experiences

2022

Crawford Fund FOR A FOOD SECURE WORLD

TABLE OF CONTENTS

AUSTRALIAN CAPITAL TERRITORY

Harry Campbell-Ross, Australian National University

Location/Focus: Philippines

Research: Assessing Smallholder Food System Resilience at a Community Scale

Other Collaborating Institutions: University of the Philippines Los Banos (UPLB)

Food security, the product of a properly functioning food system (web link)

Harry Campbell-Ross from the Australian National University recently visited the Philippines for his project assessing smallholder food system resilience at a community scale. The research involved collaboration with the University of the Philippines Los Banos.

"My research aims to take a pragmatic view in applying food system principles to policymaking with the premise that food security is the product of a properly functioning food system. I am looking at a variety of indicators from five sectors. They are markets, networks, infrastructure, natural capital, and institutions," said Harry.

"The secondary aim of my work is to create a rapid appraisal system based on the significance of each indicator's role in community and the relative ease of data collection," he added.

Action on food security often does not consider the whole food system it's influencing, Harry explained in his report. Typically, donors and governments take a disciplinary focus when trying to solve food related problems. However, taking a systemic approach to solving malnutrition is important because if this approach is not taken it can result in misguided action or inappropriate interventions that do not target the problematic components of the system.

"Another point to consider is the very meaning of "food security". Typically, there has been a clear focus on determining food security status through caloric consumption. However, this focus on calories as the measure of food security has resulted in the rise of "hidden hunger" and the "double burden of malnutrition".

"A better way to frame food security is through the consumption of a diverse range of foods to expand the focus from calories to include macro- and micro-nutrients in our framing of "food security." In this way caloric security and nutritional security are captured under the umbrella term of 'food security'," said Harry.

"More recently food security is being framed in the context of the food system. The food system is the collection of actors and their interlinked activities involved in the production, processing, distribution, consumption, and disposal of food. Again, the food system is very complex with a dizzying array of actors and activities directly and indirectly involved."

"I used my Crawford Fund Award to travel to the Philippines to complete a food-market audit, met with food vendors and interviewed municipal officials. Our discussion with these officials covered commodity markets, environmental health, crop storage, agricultural cooperatives in the municipality, infrastructure and the community's participation in village and municipal elections."

"My broad hypothesis is that with the tools to better target the components of the food system contributing to food insecurity, more people will be able to enjoy better nutrition outcomes and the flow on benefits of ongoing food security."

Using data from the market audits and census data on average incomes, Harry was able to determine the cost of a complete diet, based on Philippine government guidelines and compare it to income. From this he found that for an individual with the average income in the Nagcarlan municipality, a complete diet is unaffordable with a full weekly diet costing more than the weekly income.

"The research that will come from this trip will highlight the areas of most concern in the Nagcarlan food system to try and influence through policy, research, and investment. The engagement with the municipal government will help myself and my colleagues from UPLB see some positive outcomes from this work. The people of Nagcarlan will benefit (hopefully) from a better functioning food system and the flow on nutritional benefits that would bring," concluded Harry.

While in the Philippines, Harry also gave seven lectures at UPLB in the context of systems thinking and human ecology.

Xolile Ncube, Australian National University

Location/Focus: Zimbabwe
Research: Transforming Irrigation in Southern Africa
Other Collaborating Institutions: ACIAR Project (LWR/2016/137) hosted in country by ICRISAT

Being adaptable for scaling ag innovations (web link)

Xolile Ncube, from the Australian National University travelled to Zimbabwe to undertake research into transforming irrigation in Southern Africa, as part of an ACIAR Project (LWR/2016/137), and she was hosted in country by the International Crop Research Institute for Semi-Arid Tropics (ICRISAT).

She wrote the blog below about her experience:

Being awarded the Crawford Fund Student Award in 2022 allowed me to travel to Zimbabwe for my data collection between the months of November 2022 and February 2023. The objective of the data collection was to determine how agricultural innovations initiated by Agricultural Innovation Platforms (AIPs) under the ACIAR funded Transforming Irrigation Agriculture in Southern Africa (TISA) project were spread out to new geographical locations and embedded in institutional and cultural norms.

Through an assessment of TISA project reports and conducting semi-structured interviews with irrigation scheme members, key stakeholders at district, provincial and national level, the study found that different dimensions, strategies and mechanisms were utilised at different levels to scale agricultural innovations. The study also found that AIPs were established at scheme and district level within the targeted areas creating new social networks which are an amalgamation of the networks that the individual actors within the AIPs bring from outside the forum. These networks were key in fulfilling the function of scaling agricultural innovations outside the AIP domains.

As an early career researcher, the data collection process made me realise how complex the scaling process is and although a guide can be produced around scaling, those engaged in the process need to be adaptable as scaling can also be spontaneous due to farmers learning from each other's experiences. Figure 1 below is an example of the scaling process implemented by the TISA project in Zimbabwe , demonstrating that the process is not linear and requires a mix of scaling dimensions, strategies and mechanisms to successfully scale agricultural innovations.

Prior to embarking on this research I believed that there were only two forms of scaling which are scaling out and scaling up, but I quickly realised that there is a third scaling dimension which is scaling deep. The scaling deep dimension requires that participants of the process change their beliefs, mindsets and attitudes inorder to fully benefit from an innovation.

I also found that those involved in scaling need to be adaptable, three scaling strategies ensure that this occurs, these are scale jumping, bending and scaling down. Scale jumping is a strategy that is utilised when there is a realisation that the required outcomes will be attained at a lower level such as at the district level but at a higher level such as the national level, therefore the innovation is scaled to that level. The scale bending strategy is employed where rules and norms are challenged inorder to reach the desired outcome and impact. Scaling down, is closely linked with responsible scaling as it calls for those leading the scaling processes to stop and think about the impact of a scaling endeavor should it reach a wider geographical spread.

Scaling mechanisms are utilised to ensure that innovations reach the desired audience, these mechanisms include farmer to farmer learning, extension services facilitated learning, advocacy and lobbying, innovation championing and research-based learning.

Scaling is a concept that is not yet clearly understood within the field of agricultural research for development, this study contributes towards understanding scaling processes through empirical evidence from the TISA project.

Having a clearer and more indepth understanding of scaling will ensure that the negative impacts of scaling on receiving environments and communities are eliminated or reduced, and expansion is conducted in a sustainable and responsible manner inorder to ensure positive results at both the proof of concept and expansion stages of project implementation.

The Crawford Fund supported my travel to Zimbabwe to enhance my understanding of the concept of scaling, I currently have a paper on the concept under review, having the paper published will ensure that a wider audience has access to my scaling research and that it contributes towards the manner in which research for development approaches and implements scaling in different locations across the globe.

Bimal Sharma, University of Canberra

Location/Focus: India
Research: Patterns of Rural Community Livelihood and Managing Natural Resources in the Brahmaputra Valley of Assam, India
Other Collaborating Institutions: Morigaon College affiliated to Gauhati University, Assam, India

Exploring diversified livelihoods in rural India (web link)

Bimal Sharma, a PhD student from the University of Canberra, visited India for his research project exploring rural community livelihoods and local knowledge on landscapes in the Brahmaputra Valley of the Assam Plain in India.

"My visit to the Brahmaputra Valley of Assam Plain of India was successful post COVID-19 and flood impacts. I travelled around the agroecological zones of the Brahmaputra Valley, listened to the community, shared knowledge, learning about the culture, traditions and diversified livelihood patterns. It was a fantastic experience making real-world contact," said Bimal.

Bimal's research project aimed to address three questions:

1. What is the impact of seed fertiliser technology and climate variability on agriculture dependent livelihoods in the Brahmaputra Valley?
2. What dynamic livelihood patterns are at work in the study area?
3. Does the application of Socio-Ecological Production Landscapes (SEPLs) provide a more holistic picture of community livelihood?
4. Data was collected from household surveys and focus group discussions in each of the three agro-ecological zones – Lower, Middle and Upper Brahmaputra.

Bimal found that the increasing use of chemical fertiliser has had a direct impact on the changing agricultural productivity patterns of the valley, with the impacts most notable in the semi-humid areas of the valley. The expansion of cultivated land under high yielding varieties increased the productivity marginally in the most humid parts of the lower, as well as up to some extent in the central areas, of the valley.

"Variable rainfall in the crop system of the valley poses a fundamental challenge to the formation of different soil ecology by flooding and soil movement. The valley experiences severe flooding during the monsoon and post monsoon season and as a result crop damage and land degradation occurs. Acres of land have been abandoned due to the loss of soil quality," he explained.

In relation to the second focus of his research, Bimal found that because of the number of people and cultures, the livelihood patterns are diverse. Up to 60-70 per cent of rural people depend on agriculture as a primary livelihood in the Brahmaputra Valley. Rice is the principal crop, followed by rape and mustard, maize, wheat, sugarcane, black lentil, jute, and potatoes.

Assamese community practice traditional cultivation but, in some cases, agricultural machinery is used. As the monsoon often destroys crops because of flooding, winter crops are much safer than summer crops, and irrigation is used during the autumn season.

Assamese farmers also grow vegetables for both self-consumption and commercial purposes, and the market accessibility for vegetable sales is well-connected. Locally produced vegetables are getting more attention from customers due to the low fertiliser used.

As an alternative to agriculture or to supplement their incomes, some Assamese depend on traditional arts and crafts.

Bimal observed that young generations are interested in mushroom cultivation, piggery, beekeeping, and poultry farming. Some of those surveyed took a loan from a bank and invested in farming. They are happy with the established business from which they earn reasonable income.

"The rural population also depends on the wetland for their livelihood in the Brahmaputra Valley. Fish from wetlands are considered the best quality fish and have market demand. The government has imposed restrictions on fishing from the wetlands, which is a concern for those who depend on the wetlands for their livelihood."

Bimal also noted that there are several Self-Help Groups (SHGs) in the Brahmaputra Valley working across areas including weaving, pig and poultry farming, artisan work, and business skills. There is strong participation of women in the SHGs, which encourages female entrepreneurship and provides economic support.

"I used the methodological approach of Socio-Ecological Production Landscapes (SEPLs) to assess more holistically community livelihoods in relation to the natural resource value-based knowledge of the rural dwellers in the Brahmaputra Valley," said Bimal.

SEPLS are defined as dynamic mosaic landscapes and seascapes with habitats and land uses including villages, farmland and adjacent woods, forests, grasslands, wetlands and coastal areas. A set of indicators was developed to provide a tool for communities to understand their resilience and encourage the practices that strengthen it.

Bimal found that the three main challenges facing the rural communities in the Brahmaputra Valley were:

Flash floods, poor drainage systems (especially on farm roads) and water management resulting in loss of limited and valuable paddy fields.

Frequent river erosion and landslides causing huge loss of fertile soils, agriculture land, animal and property loss.

Wetland degradation due to human horizontal expansion for settlement.

"The farmers in the Brahmaputra Valley believe that their activities are having a worse impact than climate change in the valley, and that education for farmers is essential to understand the use of new varieties, fertilisers, insecticides, pesticides and land management to help build more resilience into the system," concluded Bimal.

NEW SOUTH WALES

Nicolette Duncan, Charles Sturt University

Location/Focus: Laos and Cambodia

Research: To determine the effectiveness and impact of fish friendly irrigation guidelines written between 2018-2020 for the Lower Mekong Basin and if and how they could be improved.

Other Collaborating Institutions: ACIAR Project 153 – FishTech: Integrating technical fisheries solutions into river development programs across South East Asia.

Fish Friendly Irrigation Guidelines for Laos and Cambodia (web link)

Nicolette Duncan, a PhD student from Charles Sturt University completed her student award research in Laos and Cambodia. Her project was associated with ACIAR Project 153 – FishTech: Integrating technical fisheries solutions into river development programs across South East Asia.

"The aim of my project was to determine the effectiveness and impact of fish friendly irrigation guidelines written between 2018-2020 for the Lower Mekong Basin and if and how they could be improved," said Nicolette.

According to Nicolette, her project aimed to determine:

1. the extent to which fish-friendly irrigation guidelines written between 2018-2020 for the Lower Mekong Basin are similar or different.
2. the extent to which fish-friendly irrigation guidelines written between 2018-2020 for the Lower Mekong Basin are perceived as useful to authors and users.
3. what actions, if any, are needed to improve fish-friendly irrigation guidelines.
4. the role that guidelines have in fish-friendly irrigation infrastructure uptake in the Lower Mekong Basin and how, if at all, this can be made more effective or impactful.

The Crawford Fund has supported earlier Charles Sturt University training in fishways over the years, associated with their projects with ACIAR. CSU is considered a leader in fish-friendly water infrastructure research, exporting their human and technical resources to several South East Asian countries said Nicolette.

International experts from ACIAR Project 153 worked together with local fisheries biologists and irrigation engineers to design and plan fishways in Cambodia.

"My research will contribute to diversifying their local research team and support their efforts, investment and reputation for improving fisheries and livelihoods through greater enhanced understanding of social and communication complexities. The output will be a published journal article which evaluates perceptions and needs of guideline users in relation to guideline formulation and design," she said.

Fishways facilitate fish migration past water infrastructure via a specially constructed channel, constituted of stepped pools that reduce the vertical height that fish must travel over dams into incremental steps, allowing fish to 'climb' over the infrastructure and continue their migration upstream. While this technology has been implemented all over the world, knowledge is still in a nascent stage, especially in the tropical rivers of South-East Asia.

CSU, with funding from ACIAR has been working with partners in the region for more than 10 years and through research and development has established fundamental principles of fishway design and function suitable for Mekong systems and its tributaries. Through the Crawford Fund supported Fish Passage Master Classes, it is sharing this information with water resource stakeholders in countries such as Lao Peoples' Democratic Republic (PDR), Cambodia and others with the aim of increasing local capacity to design and construct fish-friendly water infrastructure.

With the support of the Crawford Fund, Nicolette was able to attend a Fish Passage Master Class in Lao PDR and Cambodia. The Master Classes were jointly convened by the National University Lao, Lao Ministry of Agriculture, and CSU in Vang Vieng, Lao PDR and by the Ministry of Agriculture, Forestry and Fisheries, Fisheries Administration and CSU in Siem Reap, Cambodia.

This opportunity facilitated meeting water resource stakeholders of diverse backgrounds such as local fisheries

biologists, irrigation engineers, village leaders, provincial officers, university staff and representatives from the Mekong River Commission.

Nicolette conducted interviews with local stakeholders to further her understanding of how the target audience of fish passage guidance perceived training efforts, especially with respect to fish-friendly irrigation guideline documents. Interviews were transcribed and coded for qualitative analysis.

"The results showed that while these types of guidelines are perceived as useful by the target audience, rarely is the target audience involved in guideline creation, and a mismatch was found between user expectations of guideline documents and the guideline contents. Recommendations to improve guideline utility and uptake suggested by the target audience related to themes of governance, technical data and social factors, underlining the complexity of meeting the needs of multiple stakeholders in water resource management," she said.

Valuable insight was quickly revealed to Nicolette, as to the lived experience of interview respondents, including how the local and organisational contexts of users influences the impact and utility of guidelines, and the contribution this can make to guideline formation and fish-friendly irrigation praxis.

Site visits allowed Cambodian Master Class attendees to speak with local fishermen and gain knowledge of fish behaviour at water infrastructure sites.

She found that the reviewed guideline utility and impact could be improved by attention to five key aspects: definition of target audience; engagement of target audience in guideline design; definition of guideline scope; specificity of recommendations; and evaluation.

"This work strengthens established two-way learning relationships between Australian and regional water resource management stakeholders including Lao PDR and Cambodian government departments. It presents a novel lens through which to view the interactions between in-country implementation partners and fishway researchers, including NSW based CSU practitioners," concluded Nicolette.

The data collected in Lao PDR and Cambodia will contribute to a journal article in turn will feed into work conducted by CSU and ACIAR in the lower Mekong Basin to promote fish passage at irrigation barriers in the region.

Lucinda Middleton, Charles Darwin University

Location/Focus: Indonesia

Research: Nutrition-sensitive aquatic food systems: have mangroves been overlooked for their potential to support gendered food and nutrition security in Indonesia?

Other Collaborating Institutions: Partners include Blue Forests and Tanjungpura University (West Kalimantan, Indonesia)

Nutrition-sensitive aquatic food systems: Can mangroves support gendered food and nutrition security? (web link)

Lucinda Middleton, a PhD student at the Charles Darwin University Research Institute for the Environment and Livelihoods (RIEL) recently completed her student award research in Indonesia.

"My PhD research project examines the various pathways through which mangrove systems contribute to food and nutrition security, from a gendered perspective among households in Batu Ampar and Medan Mas villages, Kubu Raya district, West Kalimantan, Indonesia," said Lucinda.

"The findings will provide insight into the availability of mangrove foods, mangrove livelihood pathways to gendered indirect food and nutrition security and dietary diversity and data on the contribution of mangrove foods to household micro and micronutrient consumption."

According to Lucinda's report, Indonesia is home to the greatest density and diversity of mangrove forests, with 40 indigenous species spanning 30,000 square kilometres, accounting for 21% of the globe's mangroves. Coastal communities across Indonesia's islands are highly dependent on marine resources found in mangrove and associated coral reefs and seagrass meadow ecosystems, for food security and public health, with aquatic foods (AQF) remaining a mainstay of local diets in some communities.

Much of the recent research concerning Indonesian mangrove systems has focussed on conservation, management and reforestation. However, there is very little knowledge on the nutrition aspects of foods found in mangrove systems, including how they contribute to household food and nutrition security and micro and macronutrient consumption and whether mangrove-based livelihoods boost dietary diversity through income generation.

Lucinda travelled to Indonesia for a series of workshops on field methods, to visit field sites and plan activities with project partners from the Indonesian NGO Blue Forests (Yayasan Hutan Biru) and the field team in August 2022. During this period, Lucinda also delivered a guest lecture at Tanjungpura University on nutrition interventions and methods to measure food and nutrition security and nutrient intake.

This project is being implemented in collaboration with the NGO Blue Forests (as part of a CDU research partnership) and Puji Astuti from the faculty of Medicine at Tanjungpura University. The main data collection methods to be utilised are focus group discussions, participatory systems mapping, household surveys and food dairies, which will be conducted twice to capture seasonal variability in consumption. The partners have identified the need for nutritional research to support their ongoing projects on mangrove nutritional security and public health in Batu Ampar and Medan Mas villages, West Kalimantan.

Lucinda travelled to Pontianak, West Kalimantan to conduct food and nutrition security field method workshops with co-researcher Puji Astuti, five enumerators from Pontianak, and staff from Blue Ventures and Blue Forests.

Following the workshops, the team travelled to Batu Ampar village, the field site for the PhD project, to scope three potential sub-villages, obtain government support, identify potential participants for participant recruitment and observe livelihood activities. Batu Ampar is only reachable by boat and the village is spread across two islands.

"During the three days of our visit, we met with members of a women's cooperative group who run a small business producing tea from mangrove leaves and a group that glean clams. We also meet with local leaders, including the kepala desa (head of the village), the head of the forestry and fisheries co-operative for the village and kepala dusun (heads of the sub-villages) and male fishers to introduce the scope of the project.

Whilst in Batu Ampar we noticed that ultra-processed food was readily available through local shops and kiosks and widely consumed and that a major livelihood activity aside from gleaning and fishing was charcoal production using mangrove species," said Lucinda.

"These broad observations enabled the team to refine the methods and tools to measure food and nutrition security in the area to be implemented as part of the data collection commencing in October.

"During the visit the relatively new research link between CDU/RIEL and Tanjungpura University was broadened alongside our partnership with Blue Forests. This partnership with Tanjungpura University will be formalised through a Letter of Agreement," said Lucinda.

"I would like to acknowledge my co-researcher Puji Astuti, the team of enumerators which includes Firdha Kusuma Wulandari, Galuh Maharani, Susilawati, Wina Widyanti and Wulandari Pertiwi. I would also like to acknowledge the teams at Blue Forests and Blue Ventures including Sisca Nasastra Gafri, Elni Kohar, Ferina Tuhumena, Noviansyah Putra and Purwa Indra Santoso for their assistance and support during my trip and the development of this project. Thanks to Rieski Kurnisari, Kristen Deveraux, Ben Brown, and my panel for assisting with travel plans and partnership development and to the Crawford Fund for providing the funds to support travel for this trip," concluded Lucinda.

QUEENSLAND

Phoebe Arbon, James Cook University

Location/Focus: Thailand

Research: Biosecurity and genetic improvement for disease resistance in large scale shrimp aquaculture

Other Collaborating Institutions: INVE Aquaculture

Building resilience in shrimp aquaculture (web link)

Phoebe Arbon from James Cook University travelled to Japan, Singapore and Thailand for her project biosecurity and genetic improvement for disease resistance in large scale shrimp aquaculture. The research involved collaboration with INVE Aquaculture.

Global shrimp (prawn) production is significantly challenged by infectious diseases, with annual losses to production capacity of up to 40%. Fortunately, the Australian shrimp farming industry is naive to most of the pathogens that effect overseas production. However, since the outbreak of Whitespot syndrome virus (WSSV) in Southeast Queensland, which devastated regional production, the Australian shrimp farming industry has prioritised biosecurity and the pursuit of domesticated and genetically selected disease resistant stock.

"My PhD project aims to develop foundational knowledge around the impact, importance, and management of viral pathogens in Australian shrimp production to help achieve this pursuit. Through the Student Award, I travelled to Japan, Singapore and Thailand to experience and observe first-hand, on-farm management of emergent disease issues, operational biosecurity, infrastructure requirements and genetic selection technologies in industrial-scale international shrimp aquaculture," said Phoebe.

"Throughout my trip I also visited facilities culturing finfish and molluscan species, such as those using technology-driven intensive sea-based barge aquaculture systems, to learn about the latest technology related to farming in a biosecure marine environment."

Phoebe found that biosecurity adoption and application throughout East Asia is highly diverse, ranging from farms that routinely experience mass mortalities due to disease and implement very limited biosecurity protocols, to highly bio-secure production facilities that refuse visitor entry due to their strict biosecurity and the potential contamination risk we posed to their operations. Through discussions with farmers, Dr. Shinn and Dr. "March" Wongwaradechku about the ubiquity and severity of diseases on shrimp production throughout SE Asia, the importance of Australia's rigorous maintenance of aquatic biosecurity was clarified. Incursion of such exotic pathogens into Australia's production systems would unquestionably devastate our prawn farming industry and must be vehemently protected against.

"Learning from farmers and professionals in these regions about their strategies to mitigate the impacts of disease, and how they are recovering their historically disease eroded shrimp production volumes provided great insight on how Australian researchers (like myself) and prawn producers can build resilience against future disease threats."

"The knowledge and experience gained during the Award has provided me with a globally relevant perspective and broadened understanding of the impacts of infectious diseases, and how they are currently managed in aquaculture," she said.

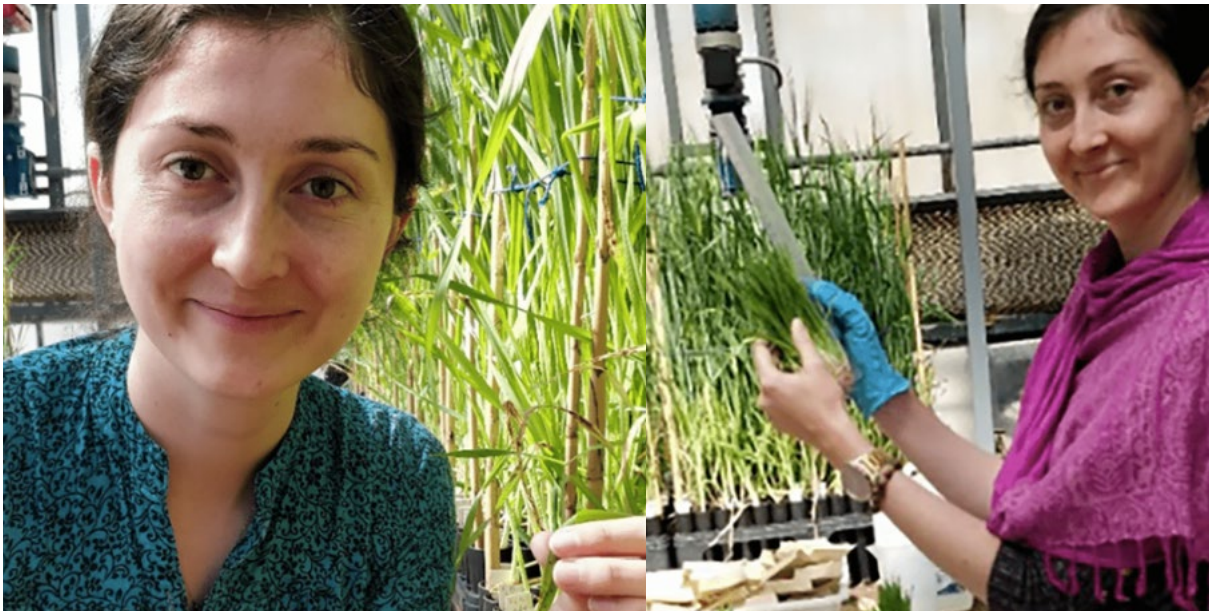
"The Award has allowed me to gain critical experience, insights, and expertise on disease mitigation, management, and resilience from farmers and leading experts in the field and develop invaluable research connections throughout Eastern Asia. These learnings will be passed on through my PhD studies and future research pursuits to my peers, colleagues, and the Queensland shrimp farming industry to support continuing development and resilience against future disease threats of the industry," she concluded.

Nakita Cally, University of Queensland

Location/Focus: Morocco

Research: Screening diverse barley accessions for resistance to net form net blotch in Queensland and Morocco

Other Collaborating Institutions: ICARDA Barley Breeding Program, Morocco



Screening barley varieties for net form net blotch resistance (web link)

Nakita Cally from the University of Queensland, visited ICARDA in Morocco for her project, 'screening diverse barley accessions for resistance to net form net blotch'. Nakita was originally going to ICARDA in Ethiopia but diverted instead to Rabat in Morocco because of the instability in East Africa.

As a recipient of the Crawford Fund Student Award, Nakita travelled to Morocco to spend time with local breeders from the ICARDA Global Barley Breeding Program based in Rabat. During her visit, Nakita gained hands-on experience working in the team of Dr Miguel Sanchez, the Lead Breeder of the Global Barley Breeding Program. In particular, she:

- had the opportunity to evaluate a range of traits in glasshouse experiments and in field trials, including disease resistance;
- learned how to score disease, in particular net blotch, and observed the outcomes of the net form of net blotch inoculation process;
- undertook collaborative genetics research to identify new sources of resistance to an important disease affecting barley crops in both Queensland and northern Africa
- inspected barley crops, which helped her gain a better understanding of the challenges faced by barley farmers in North Africa; and
- learned about a real-world breeding programme that is seeking to develop improved crops for smallholder farmers based on the challenges they face and their targets in terms of the key traits that are required in new varieties.

"The focus of my project was exploring the genetics for resistance to the foliar disease net form of net blotch (NFNB) caused by Pyrenophora teres f. teres (Ptt). It is a devastating disease for barley growers in Queensland and northern Africa, where barley is a key crop in both farming systems," Nakita explained.

According to Nakita, in Queensland and northern New South Wales, NFNB can cause yield losses above 30 per cent, making it an important pathogen to the barley industry. In Australia, NFNB causes barley production losses of up to $117 million annually. Consequently, the identification of novel sources of resistance against the pathogen is an increasing priority for the Australian barley breeding community.

The availability of low-cost whole genome marker platforms has dramatically changed how plant breeding is undertaken in recent years. The selection for durable genetic resistance to NFNB is a key focus for barley breeders. However, the genetic architecture of resistance to NFNB is complex, quantitative, and poorly understood.

"It was a great experience to be exposed to the genetic variation that the breeding programme is working with and learning how to score disease in the glasshouse and in the field," she said.

Upon return to Australia, Nakita's analysis found six novel resistance haplotypes in the ICARDA germplasm that were not found in the Australian germplasm.

"This represents an opportunity for breeders in Australia to use strategic introgression of the new resistance haplotypes to develop resistant barley varieties for Queensland growers," she said.

"The new knowledge and molecular tools will help accelerate the development of cultivars incorporating improved NFNB resistance, which is anticipated to improve productivity and sustainability of production in Queensland and northern Africa," said Nakita.

Cristina Ruano Chamorro, James Cook University

Location/Focus: Pacific Islands

Research: Advancing equity in small-scale fisheries management in the Pacific Island nations

Other Collaborating Institutions: Pacific-European Marine Partnership (PEUMP) programme on mainstreaming gender, social inclusion and human rights-based approaches in coastal fisheries

Advancing equity in Pacific Island Fisheries (web link)

Cristina Ruano-Chamorro from James Cook University recently visited Fiji for her project advancing equity in small-scale fisheries management in the Pacific Island nations. The research involved collaboration with the Pacific-European Marine Partnership (PEUMP) programme on mainstreaming gender, social inclusion and human rights-based approaches in coastal fisheries. She shares her experience below.

Small-scale fisheries (SSF) in the Pacific are critical to multiple dimensions of human wellbeing. SSF in the Pacific are often managed through co-management approaches, which are considered to be more equitable than other management approaches (e.g., state-led) because they aim to ensure decision-making power to people affected by SSF management decisions.

However, co-management often leads to inequities in the distribution of management costs and benefits and inequities in decision-making processes. For example, more powerful individuals often have more influence over decisions and are more able to capture more benefits.

“Multiple efforts are being made to promote equity in the management of small-scale fisheries (SSF) in the Pacific Island countries and territories. However, understanding of equity is often limited, therefore compromising the ability of stakeholders to promote equity in SSF management in meaningful ways,” said Cristina.

“Improving stakeholders’ understanding of what equity is and how to promote it locally is key to ensuring meaningful mainstreaming of equity in the Pacific Island fisheries,” she said.

Promoting equity in SSF management is important for both ethical and instrumental reasons. Firstly, ensuring equity is key to protecting the rights that sustain human wellbeing and dignity and secondly, equity can lead to positive social and ecological outcomes. For example, when management is equitable, people are more likely to cooperate and comply with rules, with positive implications for sustainability.

A collaborative one-day workshop was co-organised by Cristina and her colleagues to improve the understanding of the concept of equity, exchange knowledge, share learnings, and bring together the perspectives of diverse stakeholders in SSF management in Pacific Island countries and territories. They focused on what constitutes equity across its multiple dimensions, and identifying the challenges, opportunities, and potential strategies to advance equity in SSF management in the region.

A total of 29 participants representing academic, NGO, and fisheries governing institutions attended the workshop.

Participants identified equity issues in a case study from the Solomon Islands (left) and participants judged the fairness of a set of distributional justice principles (right).

Participants suggested several strategies to address equity in SSF management. Most of these strategies could be grouped into four key themes:

1. Strategies concerning data encompassed the importance of creating more research opportunities, collecting more evidence and analysing past data with an equity lens to grasp what equity means in the Pacific.
2. Leadership strategies included identifying champions and promoting leadership at multiple scales (e.g., community, regional, national).
3. Strategies associated with the cultural context included: engaging and valuing local expertise to contextualise equity; recognising examples of equity that already exist in the culture; and, integrating indigenous knowledge with modern knowledge.

4. Strategies associated with the institutionalisation of equity included promoting equity within organisations (e.g., fair recruitment practices, ensuring equitable human resources implementation, administration, equitable institutional policies, fair access to training), strengthening institutional capacity (e.g., investing in the budget, equity in planning) to promote equity and reviewing the way organizations do things in terms of equity (e.g., monitoring, evaluation).

"This workshop has improved understanding of equity among practitioners, promoted the co- production of knowledge around equity issues in SSF management and helped identify key challenges, opportunities and possible strategies for advancing equity in SSF management in Fiji and the wider Pacific Islands, as well as the role of organisations (government, NGOs and CSOs) in addressing equity issues in this context. Overall, this workshop has brought multiple benefits for the Pacific, for Australia and for me and the co-organisers of this workshop," Cristina concluded.

Madeleine Grist, University of Queensland

Location/Focus: South Sulawesi, Indonesia
Research: Value Chain Analysis of Tropical Carrageenan Seaweed Propagules in South Sulawesi
Other Collaborating Institutions: IPB University from Indonesia, with assistance from on-the-ground staff of the Commodities SIP as part of the Australia Indonesia Center Partnership for Australia-Indonesia Research.

Being on the ground for a greater understanding of seaweed farmers' lives (web link)

The Crawford Fund Student Award enabled Madeleine Grist from the University of Queensland to visit Takalar, South Sulawesi, Indonesia, which is the subject location of her honours thesis.

"The award allowed me to gain greater context for my research, by learning from researchers in the field about how they gather the best information for the project from farmers. This is something I would not have been able to do otherwise," said Madeleine.

According to Madeleine she not only gained a greater understanding and appreciation of Takalar seaweed farmers' lives and how seaweed farming is changing their lives for the better, she also learned how her research could be better presented to make it more relevant to the farmers' lives.

"I gained a greater understanding of the importance of involving the farmers in development discussions and research. Farmers want more research done in this area, but feel that initiatives, such as the government projects, are useful in theory, but do not include their practical knowledge developed over many years of farming seaweed," she said.

"I learnt a lot from the Junior Scientific Officers (JSOs) about getting involved in the community. They build relationships with the farmers and are able to get more accurate data back to the researchers and convey to researchers what the farmers want and believe the industry needs to develop," she said.

Madeleine reported that the Indonesian seaweed industry faces significant challenges such as an increased prevalence of disease, epiphyte and pest infestations, and loss of seedling quality.

The industry in Indonesia is made up of approximately one million smallholder farmers and their households, who earn profits around USD$2000 annually. These farmers mostly live in rural coastal areas and are often constrained by low levels of education, and lack of access to technology and personal capital. The main product from these seaweeds is the hydrocolloid carrageenan, which is the gelling agent used in a range of processed foods, cosmetics, and pharmaceuticals.

Most research in the field of seaweed farming focuses on the production cycle and how to improve industry productivity but miss a major precursory factor – that is how access to, and the quality of, seaweed seed impacts the quality and quantity of seaweed produced. Madeleine's research focuses on collecting this data to do a value chain analysis and determine areas in the value chain that could be improved.

It also focuses on the seaweed seed value chain, quality characteristics of what makes a 'good' seed, and how new technologies, such as new propagation techniques and Facebook pages, are changing the way seed is produced and traded.

Seaweed seed cannot be dried or kept until peak season but must be continually cultivated.

"Farmers sell their seaweed at different times and continue growing it through the low season to try and maintain an income stream. There is a strong seed trading system in Takalar and neighboring regions meaning that if farmers lose their crop due to poor weather conditions, they will be able to secure seeds for the growing season. Capital is also readily available for farmers at the start of the season," she said.

"There has been much hype around development of the Australian seaweed sector. As an emerging industry in Australia, there is much that can be learnt from the Indonesian red seaweed industry, as many of the same principles apply," she said.

Madeleine with researchers from IPB and JASUDA who were in Takalar to do interviews for a day during her trip.

"I want to thank the Crawford Fund and I especially want to thank Imran Lapong and Risya Arsyi, the field research team, for looking after my trip and taking me with you to interviews. I have such great respect for the work they are doing in Takalar. I want to thank the people of Takalar for allowing me to visit their farms and homes to learn about their lives and farming activities. Thank you also to Irisyadi from Jasuda and Nana, her family, and Dilah from AIC for meeting with and hosting me while I was in Makassar," she concluded.

Edith Kichamu, Griffith University

Location/Focus: Kenya

Research: Drivers and barriers to the realisation of effective climate smart landscapes: Stakeholder perspectives

Realising climate-smart landscapes (web link)

Edith Kichamu from Griffith University travelled to Kenya for her project to better understand stakeholder perspectives of the drivers and barriers to the adoption of effective climate-smart practices.

"My study employed the Q-method to explore factors influencing the adoption of climate-smart agricultural practices (CSA) in Kakamega County, Kenya. The study aimed to expand understanding beyond the farmers' perspectives to include viewpoints of industry experts, offering a more comprehensive view of the elements driving CSA adoption," said Edith.

The Q-method has been advanced as a methodology that can provide a detailed understanding of individuals' perspectives on complex issues by categorising the viewpoints into mental models, values, or belief systems, explained Edith. It demonstrates the fundamental trends between individuals' beliefs or perspectives.

"Stakeholder collaboration, community engagement, and robust social capital emerged as the primary drivers for CSA implementation. This reiterates the importance of collective action, local knowledge, and contextually tailored strategies for climate change adaptation and mitigation in agriculture," she said.

"Conversely, several barriers were identified, including inadequate institutional support and limited financial resources. This points to an urgent need for reinforced institutional frameworks advocating for CSA alongside the development of sufficient financial mechanisms to support its execution," she said.

Recognising the complexities of CSA implementation, Edith's study urges a holistic approach incorporating diverse perspectives in planning and decision-making processes.

"The findings from the study contribute significantly to the understanding of CSA and provide insights that can inform the design of interventions, policies, and support services for its broader implementation. The research advances academic knowledge and promotes innovative solutions that benefit land users and contribute to more effective

climate adaptation strategies," said Edith.

The research also offers valuable lessons for drier regions like Queensland, according to Edith. By understanding potential challenges and strategic insights, the study can inform policymakers and guide the formulation of relevant and effective adaptation strategies. The study's research methodology also presents an opportunity for replication with stakeholders locally, ensuring region-specific outcomes.

"This research project delivered multi-faceted benefits, providing insightful data for decision-makers, offering a robust methodology that could be replicated, and building invaluable communication capabilities. It underscores the importance of collaborative efforts and integrated approaches in successfully implementing CSA, thus informing climate change mitigation and promoting sustainable agriculture globally," she concluded.

The results from Edith's study are on track to be submitted for publication in the Global Environmental Change Journal. She hopes the research will give visibility to the importance of international agricultural research that ultimately impacts climate change mitigation and food security.

Jemma Restall, University of Queensland

Location/Focus: Pacific Islands

Research: Validation of a Method for Screening Taro (Colocasia esculenta) for Drought Tolerance.

Other Collaborating Institutions: The Pacific Community (SPC), Project: Evaluating Salinity Tolerance in Diverse Taro (Colocasia) Wild Relatives to Enhance Food Security in the Pacific Islands; Project ID: APSF21074

From orphan to staple – Taro in the Pacific (web story)

The Crawford Fund Student Award enabled Jemma Restall from the University of Queensland to visit Suva, Fiji for a one month stay at the Centre for Pacific Crops and Trees (CePaCT) within The Pacific Community (SPC).

CePaCT aims to strengthen the resilience of food and nutritional security against the impacts of climate change through the development of technology and technical advisory support services.

"The Crawford Student Award for 2022 allowed me to assist researchers within The Pacific Community to validate a method for screening taro for drought tolerance," said Jemma.

Specifically, Jemma's project involved:

- optimising the protocol around drought screening
- training researchers around phenotyping taro under drought
- setting up a plant imaging and processing system (PhenoCams) to capture plants under drought stress, and
- improving the protocol around taro DNA extraction to enrich the quality of results obtained from lines of interest sent for genomic sequencing.

There has been increasing attention highlighting that Pacific Island nations are among the most vulnerable to climate change, with contrasting extreme weather events such as drought and saltwater inundation of farmland, increasing in frequency. The use of drought tolerant crops in production systems is one approach that would allow countries to continue growing their own food and maintain self-sufficiency.

According to Jemma, many crops relied on for regional food security in the Pacific are considered orphan (or minor) crops elsewhere around the word – including taro (Colocasia esculenta). It is a staple food source with tremendous cultural significance, but its ability to continue to be grown into the future is reliant upon independent cultivars, that are tolerant to abiotic stress.

The corm (underground root), leaves and stalks of the taro plant are eaten for their high carbohydrate, fibre, protein, vitamin and mineral content. Considered a prestige crop, taro has been the plant of choice for traditional feasts, gifts and fulfilling social obligations for centuries in many Pacific Island communities.

CePaCT holds the Regional Germplasm Centre, which conserves the genetic resources of the region's staple crops and it houses the world's largest collection of taro diversity – over 1000 accessions.

"A major research objective of my trip was to optimise the time and labour-intensive drought screening protocol that was being used. With the help of Dr Millicent Smith and previous studies, I was able to deliver a new protocol for the team that drastically reduced the workload and strain on the bodies of researchers. These changes led to researchers having a greater than 50% decrease in their workload," said Jemma.

Further, the protocol was improved to ensure plants receiving a 'drought treatment' now receive a watering rate similar to that of drought conditions (20% field capacity) to enable the trial to run for a longer period of time to investigate the effect of prolonged drought periods on taro.

Jemma's in-person training of researchers was enhanced by the creation of step-by-step instructional documents for future reference.

While in Fiji, Jemma also set up a PhenoCam system to record images of the drought trials undertaken. These images will later be remotely analysed once a processing pipeline is optimised at UQ (to be completed as part of her PhD in 2023). Once optimised, the hope is this PhenoCam network will be used for automated plant phenotyping.

"The final research objective was working to optimise the DNA extraction method for taro. DNA extractions were trialled on site at CePaCT and some amendments were suggested, however I aim to further optimise the protocol. Once finalised the protocol will be made available to CePaCT and other Pacific taro researchers," said Jemma.

"I was also able to assist researchers in developing their skillset and confidence in carrying out DNA and RNA extractions, as well as running polymerase chain reactions (PCR)."

"Gaining experience with general cultivation and maintenance of taro greatly improved my skillset," she said.

"One of the biggest opportunities this award granted me was the ability to build a professional and personal partnership with researchers at CePaCT. In my view, this trip has cemented working relationships between researchers at The University of Queensland and The Pacific Community, and further enhanced Queensland's reputation as a hub of excellence in tropical agriculture and good regional neighbour."

"I'm extremely grateful to all staff at CePaCT for so warmly inviting me into their team. I would like to thank my supervisory team and colleagues at UQ and the Crawford Fund for making this whole experience possible." Jemma concluded.

Bethany Smith, James Cook University

Location/Focus: Solomon Islands

Research: Assessing risk within social-ecological systems: Using capacity building to operationalise a spatial decision support tool, guiding resilient livelihood development in Solomon Islands.

Other Collaborating Institutions: ACIAR Project: Spatially Integrated Approach to Support a Portfolio of Livelihoods (SRA No: FIS/2020/111)

Supporting a "portfolio of livelihoods" in the Solomon Islands (web link)

Bethany Smith from James Cook University went to the Western Province of the Solomon Islands for her research as part of an ACIAR funded project 'Spatially Integrated Approach to Support a Portfolio of Livelihoods' (SRA FIS/2020/111). Bethany travelled with colleagues from James Cook University as part of her Crawford Fund Student Award experience which allowed her to translate her PhD research into practical outputs.

Coastal areas in Solomon Islands, like many Pacific locations, face a complex array of challenges. These coastal communities are characterised by diverse and interacting activities and actors. This includes fishing, farming, aquaculture, logging, palm oil, tourism etc., which all compete for limited natural resources. These activities are threatened by many outside influences such as climate change, global market trends, trading interests, local resource use, customs, and practices.

Recognising the need for a holistic multi-sectoral approach to livelihoods planning, the Australian Centre for International Agricultural Research (ACIAR) funded the 'Spatially Integrated Approach to Support a Portfolio of Livelihoods' in Western Province, Solomon Islands explained Bethany.

The project was guided by four main objectives:

1. to develop an integrated risk-based approach to livelihoods planning,
2. foster governance processes and partnerships to sustain this approach,
3. build scientific capacity among local stakeholders, and
4. provide capacity development to support partner communities.

It also had a particular focus on promoting fair societies, sustainable natural resource use, and resilient livelihoods in coastal communities.

"Supported by the Crawford Fund grant, I participated in knowledge sharing and dissemination related to the project's risk-based participatory approach to integrated livelihoods planning," said Bethany.

"Results centred around a Livelihoods-Based Risk Profiling Framework (LRPF) which identified local risk factors in coastal communities (comprising my PhD thesis), and national open-access spatial layers of key risks related to resource exploitation and climate change," she said.

Crawford Fund grant activities and their alignment with the primary objectives of the integrated livelihoods approach.

"At the governance stakeholder workshop, we presented the overall outputs of the Integrated Livelihoods Approach to stakeholders from partner communities, and provincial and national government. I presented my PhD thesis results for workshop attendees and demonstrated the value of the approach as an integrated tool for livelihoods planning," said Bethany.

A training workshop was held with Ecological Solutions Solomon Islands (ESSI) following a 'train the trainer' format, supporting staff members in implementing and delivering outputs from the Integrated Livelihoods Approach.

The final activity supported by this grant involved partner community workshops communicating risk-based participatory assessments to our three partner communities in Western Province, Solomon Islands. The outputs of these assessments were presented as livelihoods risk profiles for each community, identifying the main social, economic, and environmental factors that drive risks to local livelihoods. These risk profiles were translated into educational posters in Solomon Island Pijin. Each community was additionally provided with a detailed risk profile report.

Community, provincial, and national stakeholders define and communicate their priority initiatives for livelihood development.

The integrated livelihoods approach provided valuable insights into the risk drivers that influence rural livelihoods in Western Province, Solomon Islands. The approach brought to light the intricate interplay between climatic change (e.g., sea level rise, temperature change and rainfall variability), and non-climatic challenges (e.g., resource exploitation) which often compound to impact local livelihoods. This was particularly evident in rural coastal areas, where communities heavily depended on natural resources for essentials like water, food, shelter, energy, and income.

The approach also highlighted the pivotal role of social and economic factors in addressing risk. For example, factors such as community cohesion, and economic opportunities emerged as crucial in adapting to the impacts of climate change.

"The insights gained from the integrated livelihoods approach can support livelihood planning projects in Solomon Islands. By identifying the intricate nature of risks impacting coastal livelihoods, the approach offers a nuanced perspective that is crucial for effective planning and livelihood planners in Solomon Islands can devise more informed and integrated adaptation strategies that address the divers needs and vulnerabilities of communities. Ultimately, this can contribute to the development of resilient livelihoods that are capable of thriving amidst changing local conditions," said Bethany.

QGIS training activities were held with staff from local partner Ecological Solutions Solomon Islands.

"Beyond the Solomon Islands, the project's findings and methodologies could also benefit Queensland, helping rural communities plan for resilient and adaptable livelihoods amidst global change," she said.

"The grant has given me the opportunity to translate my PhD research into practical outputs and communicate this information with the communities it aims to support," concluded Bethany.

TASMANIA

Loic Fery, University of Tasmania
Location/Focus: Fiji
Research: Landcare – an agricultural extension and community development model atdistrict and national scale.
Other Collaborating Institutions: ACIAR Project Landcare – an agricultural extension and community development model at district and national scale in Fiji (Project Code: SSS/2019/140)

Building diverse, productive and resilient farming systems in Fiji (web link)

Loic, from the University of Tasmania, travelled to Fiji to be immersed in ACIAR's 'Project Landcare – an agricultural extension and community development model at district and national scale'.

"The Crawford Fund granted me the opportunity, through my environmental science studies, to work, participate and research as part of the Australian Centre for International Agricultural Research (ACIAR) Landcare Fiji project," said Loic.

"The Crawford Fund allowed me to connect to farmers, project leaders, extension officers and agroforestry scientists and gain experience into how local communities have been building diverse, productive and resilient farming systems," he said.

"I immersed myself into Fijian agricultural systems and communities for two weeks in July 2024 which enabled me to explore further my passion for sustainable farming systems.

The project had four major components:

1. Work, participation and research in: ACIAR Landcare – Livelihood Improvement through Facilitated Extension (LIFE) project
2. Visits and discussions with Leader Farmers and Facilitators from sustainable agriculture Non Government Organisation (NGO) Teitei Taveuni and Nakavika community
3. Planting and maintenance in the agroforestry riparian buffer zone being initiated through Fiji National University (FNU) and the LIFE project with the Nakavika farming community
4. Forming connections with Fijian agrarian counterparts

Loic also contributed to the establishment of a riparian buffer zone to stabilise the riverbank and prevent further soil erosion caused by flooding.

After eight years working to support sustainable farming practices and improved livelihoods in the conflict-affected areas of the Philippines, ACIAR's Landcare project 'LIFE' model is now being trialled in Fiji. It aims to bring smallholder farmers together to improve climate change resilience, management of natural resources, agricultural productivity and gender equality."

"As established within the science of ecosystems ecology, more diversity correlates with more productivity and more resilience towards change. This central component of sustainable agriculture requires both innovation in systems design and dedicated management in order to work smoothly," explained Loic.

"Both in Taveuni and Nakivika, I was shown the implementation of such diversification strategies and their early success. Lead Farmers, with the guidance and assistance of Teitei Taveuni's work, Fiji National University and the 'LIFE' project have gone on to include: raising livestock like poultry and swine for nutrition and for increases in on-farm fertility loops, building seedling nurseries, agroforestry multi layered farming, intercropping and the transition towards sustainable organic fertilisers which promote greater diversity in the soil food web, and building soil fertility," he said.

"One of the more pivotal learnings was witnessing the bottom-up extension approach taken through the collaborations on this project. Centring the focus on the communities' most motivated and influential farmers showed clear success in creating many positive ripples throughout the local and wider agrarian communities."

"The Lead Farmers are key cornerstones of their community for a number of reasons. Through their adopted farming practices they: set an example, empower community, cultivate knowledge, create an inter-generational seed bank, foster diverse ecosystems and build vital soil fertility for decades to come," he said.

As part of FNU's and ACIAR's collaboration with the Nakavika community to implement a multi-purpose riparian buffer zone bordering the farmer's fields with the annually flooding Sigatoka river, Loic was invited to be involved in talking to the farmers and understanding the initial challenges with the project's uptake and find ways to re-strengthen it. The buffer zone seeks to stabilise the eroding sandy banks of the farmers fields whilst offering alternative income through a Tahitian chestnut crop and precious dry season fodder for the farmers' bullocks.

Loic said that after four days of work in Nakavika with the farming community, it was clear that support and maintenance of the riparian buffer had continued following from initial works in 2023. However, due to a lack of animal fodder during the dry season, priorities to feed the cattle came out on top and as a result the zone was not fenced off and some of the new plantings and seedlings were lost.

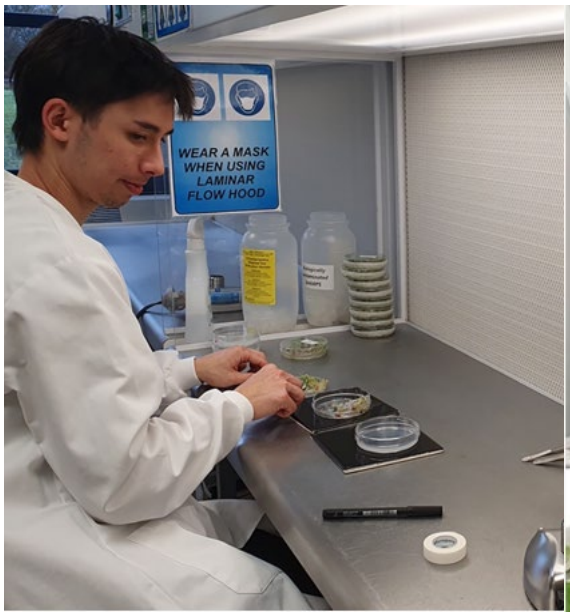
"Across three days and some well earned river cool offs between time on the tools, young Leader Farmer Meli and I undertook maintenance and planting of over 50 extra Vetiver grass clumps as well as 26 new Tahititan chestnuts trees along the river bank.

"Going forward, in order to protect the young chestnut seedlings from grazing, the farmers agreed to build a multi-purpose living fence which will keep cattle out whilst offering fodder on the shoots of the recently planted posts. Branches from fast growing, leguminous trees cut to about two metres in height are plugged into the ground and commonly used around Fiji as living fences. Tied together with lengths of barb wire, they are a great way to fence livestock and offer them some valuable perennial based nutrition," he said

Loic's personal findings and conclusions from his Student Award experience can be summarised as:

- Forming connections beyond online networks is valuable, for building partnerships, sharing knowledge and keeping good relations.
- Diverse farming systems provides better economic prosperity, food security, ecological integrity and healthy communities.
- Community-based extension principles can rapidly enhance agricultural livelihoods by improving farmer-based learning networks and community social capital.
- Lead Farmers provide good emphasis and examples for surrounding agricultural networks and will be knowledge carriers for resilient and sustainable farming practice into the future.

Oscar Fung, The University of Melbourne
Location/Focus: United Kingdom
Research: CRISPR-Cas9 gene editing to improve plant growth and grain quality of bread wheat.
Other Collaborating Institutions: The John Innes Centre, UK and CIMMYT, Mexico.



Improving the nutrition and stress tolerance of wheat using gene editing (web link)

Oscar Fung, a PhD student from the University of Melbourne, visited the John Innes Centre in the United Kingdom to learn the latest CRISPR-Cas9 gene editing techniques to improve the plant growth and grain quality of bread wheat.

The John Innes Centre in the United Kingdom (top) and Oscar at work in the laboratory.

"The Crawford Fund Student Award enabled me to travel to the John Innes Centre in the United Kingdom where I learnt the latest open access techniques in bread wheat transformation and gene editing," said Oscar.

"My PhD research uses biotechnological strategies such as CRISPR-Cas9 gene editing to improve nutrition and plant growth in bread wheat. However, CRISPR-Cas9- based gene editing in wheat is challenging due to its complex genome and low regeneration efficiency from tissue culture," he explained.

Oscar explained that although bread wheat is grown on more land than any other crop and produces one-fifth of the calories consumed by humans, conventional breeding methods can take up to 12 years to develop a new bread wheat variety. Biotechnological strategies, on the other hand, offer a more precise approach to enhancing crop traits and recent legislative changes in Australia have increased the feasibility of introducing gene edited to growers and consumers.

"Gene editing via CRISPR-Cas9 is an emerging toolkit for plant breeders, however, published examples of gene editing in bread wheat are rare, mainly due to its complex genome and low regeneration efficiency. In addition, few Australian laboratories have the capacity to insert DNA segments into the bread wheat genome and regenerate healthy plants. Some laboratories employ IP-protected transformation methods. The John Innes Centre in the United Kingdom houses a world-class crop transformation platform (BRACT) that use open-access protocols including a new technique that incorporates a chimeric protein (GRF-GIF). This protein increases wheat regeneration from 33% to 78%, representing a huge leap forward in bread wheat biotechnology," said Oscar.

"Upon my arrival, I joined Professor Cristobal Uauy's laboratory. Crisobal Uauy is a highly respected group leader at the John Innes Centre and a world-renowned wheat geneticist. I was able to work with researchers and technicians who guided me throughout the bread wheat transformation and CRISPR-Cas9 gene editing process," he said.

After five months, Oscar had generated around 100 bread wheat plants with five different CRISPR- Cas9 transgenes, with these bread wheat varieties representing novel strategies to improve nutrition and stress tolerance in bread wheat.

"Around half of my plants have reached maturity and are ready for harvest in a glasshouse at the John Innes Centre. I will return to the John Innes Centre in the second half of 2023 to screen for mutations and identify a smaller number of plants that no longer contain the transgene. The resulting grain will be sent to the Post-Entry Quarantine facility at the Australian Grains Genebank in Horsham, Victoria," he said

After isolating any interesting mutations, Oscar will conduct hydroponic, glasshouse and field trials to assess the effect of those mutations on grain nutritional content and tolerance to stress conditions such as iron deficiency.

"Few research groups in Australia have grown gene edited wheat under field conditions. These gene edited lines represent highly innovative strategies for increased nutrition and stress tolerance in the globally and locally important bread wheat crop," he said.

Australia has recently changed legislation to make working on gene-edited crops in Australia more efficient. Tools like CRISPR- based gene editing may become integral to the toolkit used by plant breeders to develop new crop varieties explained Oscar, so it is crucial for Australia to stay updated on the latest biotechnological strategies for crop improvement.

“Thanks to the Crawford Fund, I had the opportunity to travel to the John Innes Centre and collaborate with global leaders in bread wheat research, such as Cristobal Uauy, and gain expertise in all aspects of gene editing in bread wheat. I now possess the knowledge and connections to introduce the latest open-access approaches in plant biotechnology to Australia,” said Oscar.

“The most valuable outcome of my research visit was the connections I fostered with numerous researchers at the John Innes Centre. They formed a supportive and collaborative community of outstanding researchers who were always willing to help. The research visit broadened my expertise and fostered valuable collaborations, positioning me to contribute to the advancement of bread wheat research in Australia,” he concluded.

Amelia Hawkins, The University of Western Australia
Location/Focus: Brazil
Research: Catalyzing and Learning through Private Sector Engagement (CAL-PSE).
Other Collaborating Institutions: International Centre for Tropical Agriculture (CIAT) and University of Sao Paulo (ESALQ).

Sustainable management of multi-functional landscapes in Brazil (web link)

Amelia Hawkins from the University of Western Australia recently completed her research visit to Brazil where she was involved with a collaborative project with the International Centre for Tropical Agriculture (CIAT) and University of Sao Paulo (ESALQ). During her two-month internship in Brazil, Amelia was engaged in two separate projects, with two distinct objectives.

The first project was in collaboration with the International Centre for Tropical Agriculture/Biodiversity Alliance (CIAT), supporting their Catalysing and Learning through Private Sector Engagement (CAL-PSE) initiative. She developed a policy brief addressing the key gaps and opportunities in biodiversity conservation for private actors operating in the Brazilian Amazon. CIAT is developing a new biodiversity monitoring tool called TerraBio, and this research helps identify which private actors may be able to implement it for improved stewardship of biodiversity.

The second project she was involved in was called CANOPIES – Coexistence of Agriculture and Nature: Optimisation and Planning for Integration of Ecosystem Services. This was under the supervision of the Centre for Nuclear Agriculture (CENA) at the University of Sao Paulo. Her role was mapping soil organic carbon across different kinds of pasture systems and evaluating their alignment with Brazil's national low-carbon agriculture strategy (Plano ABC+). This project is ongoing, and Amelia will use elements of this research for her Masters thesis.

Soil degradation and restoration, sugar cane production and agroecology projects were all part of the experience for Amelia and helped to shape her understanding of the environment she was operating in and researching.

"Although different in scope and requirements, these two projects ultimately both sought the same outcome: to achieve the sustainable management of multifunctional landscapes," said Amelia.

"My Crawford Fund Student Award enabled me to engage directly in-person with project stakeholders, and to visit landscapes similar to that I was conducting research on. I think it is very important to see and understand the dynamics and multifunctionality of a landscape in-person, "said Amelia.

"I was able to visit a range of corporate farms, protected areas, agroforestry smallholdings, and restoration sites. These experiences had a huge impact in terms of shaping my understanding of the environment I was operating in and informed my critical analysis process."

The problem of biodiversity loss in Brazil is well-known and there are many actors out there seeking to reverse or prevent this pattern, according to Amelia.

"My work with CIAT is one such effort, however with a slightly different approach. The CAL-PSE project recognises the underperformance of the public sector with regards to achieving biodiversity conservation goals and is trying to instead engage the private sector. This approach is applicable anywhere there exists a trade-off between agriculture and environmental protection."

"This internship enabled me to develop a systems-thinking approach, and to understand a Theory of Change around biodiversity conservation. I gained exposure to a range of new ideas and strategies as well as contact with leading international researchers in this field.

Amelia also sees relevance from her research in an Australian context too where biodiversity loss is a significant issue and is clearly on the agenda nationally and internationally.

"The approach to private sector engagement detailed in my policy brief has also been endorsed in the Australian federal government's latest State of the Environment report, where recommendations are made for public actors to

create the required enabling environment to encourage private investment in conservation initiatives," she said.

"My internship also enabled me to develop strong professional relationships with both Australian and Brazilian researchers who are engaged in work that is very much in my field of interest," said Amelia.

The policy brief Amelia developed with CIAT is undergoing internal review. Her research with CENA-USP is still in progress on a remote basis and will hopefully be used as context for her thesis.

"I would like to extend my gratitude to Dr. Wendy Francesconi, my supervisor and mentor at CIAT for her kindness, patience and critical insights in guiding me through the project policy brief. I would also like to thank Dr. Vicky Ballester for having me in her department, and for guiding my research process with Dr. Rodnei Rizzo. Rodnei was a great mentor, and I would like to extend my thanks to him for welcoming me into the office and imparting his knowledge and understanding of various mapping tools. Lastly, I would like to thank the Crawford Fund for affording me the opportunity to undertake these projects in Brazil, and for creating a platform for students to pursue international agricultural research. I have been deeply inspired by the stories of the other awardees and look forward to following their research pursuits into the future," concluded Amelia.

Crawford Fund FOR A FOOD SECURE WORLD

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