Student Awards 2018

Report Summary Compilation

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AUSTRALIAN CAPITAL TERRITORY

Kick-Starting Rice Research and Production Knowledge

Jacinta Watkins, Australian National University

Jacinta Watkins, a Canberra university student undertaking a PhD focused on nutritional biofortification, recently participated in the Rice: Research to Production course at the International Rice Research Institute (IRRI) in the Philippines, with a global cohort including students, extensions workers and laboratory leaders from the Philippines, Thailand, India, Chile, the USA, England, Nepal, Indonesia, Vietnam, and two other Australian students also funded by the Crawford Fund.

"I went to IRRI knowing virtually nothing about how rice is grown. This course was therefore invaluable for my research to really facilitate my understanding of this crop learning from a broad range of scientists who perform state of the art research in their respective fields," said Jacinta.

Jacinta in the mud learning to use a small-scale mechanised hand tractor which is slowly replacing the carabao to plow the fields and driving a tractor.

The classroom-based units covered a diverse range of topics including different rice ecosystems, the different methods of weeds, pathogens and pest control, to molecular biology, phenotyping and breeding techniques.

"Many of the sessions were also accompanied with practical experiences which I viewed as the strength of this course. One of the highlights was getting out into the field to learn both traditional and modern methods of land preparation, which included the use of a carabao (water buffalo), small-scale machines (such as the Hydrotiller) and using the tractor," she said.

"Another highlight was interacting with the local farmers. We talked to both local farmers who are part of a cooperative that regularly use technologies and also subsistence farmers from a different province who were very traditional in their approaches," said Jacinta.

"Interacting with farmers made all participants realise that if we want to translate our research we also need an understanding of farmers' social situation and needs. Both groups of farmers were concerned about the future of rice production and agriculture in general as young people are not interested in becoming rice farmers. This was eye opening for me as engaging youth in agriculture will become a big part of future food security and is something I had not considered before."

The Australian participants of the Rice Research to Production course, all funded by the Crawford Fund, visiting the International Rice Genebank. Left to right, Brooke Kaveney, Rachael Wood and Jacinta Watkins.

"Going into the course I didn't expect the social and cultural aspects of rice farming to be one of the main things I would take away from this experience as it has ultimately led me to gain a much deeper appreciation of how much effort goes into producing rice."

"This course really kick-started my understanding of this crop. It was an invaluable networking experience and I hope that I will get the opportunity to work with the people I met in the future. Overall, I highly recommend that anyone who works with rice or with agriculture in general, either in a research capacity or in the government sector should strongly consider attending this course," she concluded.

NEW SOUTH WALES

Establishing Sustainable Pest Management for Cambodian Rice Farmers

Lucinda Dunn, University of Sydney

Lucinda recently travelled to Cambodia to investigate the social and ecological constraints of rice pest management in Cambodia with the purpose of developing a sustainable integrated pest management regime for smallholder farmers. Lucinda's research is part of an ACIAR project titled, Sustainable intensification and diversification in the lowland rice system in Northwest Cambodia.

Rice is Cambodia's most economically important crop and plays an essential role in food security. Of the 3.7 million hectares of cultivated land, 2.7 million hectares (75%) is dedicated to rice production. The majority of rice is produced by smallholder subsistence farmers who typically run low input rainfed production systems as the primary source of food and income. Though the incidence of rice cultivation is high, rice yields in Cambodia are among the lowest in Southeast Asia with pest incidence and ineffective pest control mechanisms having devastating impacts.

Currently, the most common method of pest control is broad-spectrum pesticides, and over a 10-year period from 2002 the import of pesticides increased 17-fold in Cambodia. However, farmers are often misusing pesticides and are unaware of any alternative or integrated pest control methods. Furthermore, the information farmers received on how to treat insect infestation is most often from the pesticide seller's themselves. Thus, a cycle of ineffective pest control measures and lack of unbiased knowledge and advice promotes pest infestation.

It is essential to determine an optimal pest strategy with low environmental impact and high sustainability to improve rice production for Cambodian farmers. One such method is integrated pest management (IPM), which includes the use of multiple alternative cultural, physical, biological and chemical techniques and methods to reduce the pest population below the economic injury level.

To-date, adoption of IPM strategies has been hindered by the farmers' lack of knowledge of alternative pest control measures; poor site-specific research into the diversity, abundance, interactions and function of insect pests and

predators within the rice agroecosystems in Cambodia; and a lack of understanding of current farmer perceptions, management approaches and requirements, and how these are affecting rice and ecosystem productivity.

To ensure successful information dissemination and adoption of IPM methods, research is needed to identify acceptable adoption and translation strategies in the Cambodian context. Lucinda's research involved both identifying the insects in the rice fields and surveying local farmers.

"I identified a multitude of pest and predatory insects in the rice fields, with beneficial insects appearing in significantly higher numbers. Furthermore, I collected initial data on farmers knowledge, attitudes and practices of insect pests and management."

"For my ecological experiments, I wanted to answer the questions; what diversity and abundance of pests and predators within the rice agroecosystems and how does the landscape composition of the rice field impact the pest/predator networks? In doing this, I anticipated being able to help farmers identify what insects are there, and in particular, what insects are beneficial or detrimental. I sampled insects from 17 rice fields belonging to farmers within Svay Cheat Village in Battambang Province."

"I am currently in the process of identifying my 1000s of insects. I want to establish factors such as what insects are present, abundance and diversity of pests and predators and the ecological networks between these insects."

"To complement my field data, I wrote and performed farmer surveys which were developed to collect baseline data on the knowledge, attitudes and practices Cambodian farmers have towards rice pests, natural enemies, management practices and their sources of information I uploaded the survey onto Android tablets and had it translated into Khmer. I hope to be able to use this data towards developing a pest identification and management of smartphone application," said Lucinda.

Cambodian University of Battambang Masters students helped Lucinda undertake farmer surveys. From these surveys, it was easy to identify what pests farmers think are most prominent; how many farmers can differentiate pests from beneficial insects; what their opinions are towards beneficial insects; how farmers manage pests; their attitudes towards the use of pesticides; and, their knowledge and attitudes towards alternative pest control practices.

"My trip to Cambodia and working with the farmers was a trip of significant discovery and an immense learning opportunity. Undertaking this fieldwork was essential for me to progress in my PhD. From the data I have collected so far, I have discovered and learnt many things."

"During my field sampling, I was surprised at the immense abundance of beneficial insects, in particular, spiders, ladybeetles and damselflies. However, there were still various pests present. Even though I unable to assess the damage being caused by the pests, the ratio of the beneficial insects present was consistently higher than that of pest insects, questioning the need for insecticide use at all. An outcome I was not expecting because of what was written in the literature and said by farmers was often opposed to this."

The farmers' responses to some survey questions, particularly when relating it directly back to the results of the field sampling yielded some exciting results, and ultimately more questions.

The findings from Lucinda's project work have highlighted and reaffirmed the many issues of pest control in Cambodia, including no alternative or IPM methods other than chemicals are used, and importantly, farmers are unaware of such alternatives; many farmers identified one of the most beneficial insects in the rice fields to be a pest; and there was a large population of beneficial insects present and while farmers still spray chemicals to control pests, they only seemingly spray once a season.

"My findings are interesting as it could lead to a smoother transition of the complete reduction or end to chemical use in conjunction with the education and promotion of beneficial insects, namely ladybeetles and spiders. These are useful findings to begin planning what type of educational and management recommendations are required for the smartphone application," said Lucinda.

"The benefits of my project work will be significant for Cambodia, Southeast Asia and Australia. For farmers, it is to help develop their educational and management decision capacity. My research will provide farmers with knowledge

on how to identify and control pests for increased production. For the environment, my research will enhance our understanding of its ecosystem networks and the health and sustainability of the environment as a whole."

"For Australia, and New South Wales, in particular, my research will create awareness and add innovation to rice pest management. Also, my surveys can be adapted to be used as a model to create a pest management smartphone application for rice farmers in NSW. As a whole, my participation and research in Cambodia will strengthen mutually beneficial research connections between Australian and Cambodian government and educational organisations."

"This experience provided by the Crawford Fund was educationally and personally rewarding. I would like to thank the Crawford Fund for providing me with the Student Award which allowed me to fulfil my first season of fieldwork. I would like to acknowledge and give my thanks to the Cambodian farmers and their families for allowing me to work on their farms and taking part in my survey. I would also like to thank one particular family, the Vantha family for being so kind, welcoming us into their homes, sharing their food and thoughts. I would also like to acknowledge the project leaders, Dr Daniel Tan, Dr Bob Martin and Dr Yorn Try, University of Battambang students, all other project employees and researchers and everyone else involved in the ACIAR project CSE/2015/044 for their contribution and support. Thank you to my supervisors, Dr Tanya Latty, Dr Daniel Tan and Dr Mark Stevens," concluded Lucinda.

Exploring New Practices for Cambodia's Cassava Growers

Jessica Fearnley, University of Sydney

As part of her Crawford Fund Student Travel Award Jessica Fearnley travelled to Cambodia to be involved in the ACIAR project Uptake of agricultural technologies and best practices amongst farmers in Battambang and Pailin provinces, Cambodia overseen by Dr Stephanie Montgomery. The project aims to study why farmers make decisions, identify connections between needs and technologies as well as test extension and option using partnerships and demonstrations.

The project is carried out on two trial sites; one nestled in the mountains of Pailin, just off the Thailand border and one in the scenic valley of Samlout.

"My work involved looking at local orchards across this area for insect and disease pressures. I also investigated the incidence of mosaic virus in cassava to determine how widespread the disease had become in Cambodian crops," said Jessica.

Cassava is used as a staple feedstock for animals in Cambodia, providing a steady income for families. It is extensively cultivated as an annual crop for its edible starchy tuberous root, but because of the growing and harvesting methods used, continuous production of cassava can lead to soil nutrient depletion, and on sloping land, cassava cultivation can also cause severe erosion if the crop is not managed correctly.

"Soils in the Battambang and Pailin provinces are well structured, very rich in nutrients and highly fertile, but the continued use of cassava in these areas will deplete this natural resource," said Jessica.

"Current research is looking into the transition of cassava crops into orchards for an increased preservation of the soil in these areas. However, only in the last few years have researchers looked into the type of insect pressures and diseases that may be experienced in these areas if the transition is made."

"I scouted around 20 orchards in my three weeks in Cambodia, where I was able to collect samples to help identify insects and benchmark pressures around the area, including the various fungal and bacterial diseases that were prominent across the orchards, and collate the results," she said.

"Many of the challenges I faced were common for international researchers – lack of resources and access to equipment, and for the growers and researchers, lack of mechanisation and access to insecticides and fungicides," said Jessica.

"My personal challenges included acclimatising to the humid conditions with a heightened sensitivity due to malaria medication, and my limited Khmer made it difficult to explain what I was doing in a local's orchard with my clipboard and blue insect net, but I quickly had a routine to show them I meant no harm to their fruit – it helped that Khmer people are also very friendly."

"I was very lucky to not only expand my knowledge of agricultural systems and learn new farming practices, but I was able to immerse myself in the Cambodian culture, being away from the usual touristy areas of Siem Reap and Phnom Phen. I even got to experience a traditional cooking class at Nary's Kitchen and practice my peak hour bike riding skills. I want to thank the Crawford Fund for giving me this opportunity to participate in this program, it has given me a once in a lifetime opportunity," she concluded.

Developing Scientific Collaboration for a Hunger Free World at IRRI

Brooke Kaveney, Charles Sturt University

Brooke Kaveney attended the 'Rice Research to Production course' at the International Rice Research Institute in August 2018 with two other Australian university students, who were also supported by the Crawford Fund.

"This course provided fantastic opportunities for myself and many international young scientists interested in agriculture and rice production. Throughout the three weeks we were trained by leading researchers in every facet of rice production, from trait selection and breeding right through to improving harvesting efficiency" said Brooke.

The Australian participants of the Rice Research to Production course, all funded by the Crawford Fund, visiting the International Rice Genebank.

"Attending this course not only greatly improved my rice knowledge and research skills, but also highlighted the importance of scientific collaboration in developing a hunger free world. Despite the broad range of topics that were discussed, the one common message that was prominent in each lecture was the ability of agricultural science to help improve global food security."

Brooke attended the course with another 17 young scientists who were from India, Indonesia, Thailand, Vietnam, America, Chile, Philippines, England and Australia.

Brooke found the opportunity to interact and travel with other like-minded students was a genuine highlight of the course with positive benefits for the future.

"As a large group we all attended training and weekend trips throughout the duration of the course. Being exposed to enthusiastic like-minded researchers was a fantastic opportunity to further expand scientific networks and broaden my research understanding. I have remained in contact with many of the course participants and hope that the time spent together at IRRI may provide opportunities for future collaborations. Similarly, being exposed to leading researchers in rice research allowed the opportunity to develop networks that I would previously have never had access to," she said.

The hands-on nature of the course really appealed to Brooke and the other Australian attendees, who enjoyed plant pollination in the laboratory, visiting the gene seed bank, getting muddy trying traditional and modern planting methods, and learning about grain storage techniques.

"We were exposed to scientists that were key in developing rice varieties throughout the green revolution as well as the revolutionary golden rice and we were fortunate enough to interview local rice farmers about challenges regarding rice production and work as groups to brainstorm scientific proposals that focused on these issues," she said.

The Australian participants of the Rice Research to Production course, all funded by the Crawford Fund, visiting the rice terraces of Banaue.

"Although my current PhD research is primarily focused on soil biochemistry, I am involved in rice sustainability projects in Vietnam. Before attending the course, I had a basic understanding of rice research but lacked the breadth and depth of knowledge regarding the more intricate facets of rice science. The course explained in detail how various traits are picked depending on particular requirements and consequently how a breeding program is then formulated to develop a new variety," she said.

"Opportunities like this not only improved my scientific knowledge but also helped develop skills in proposal writing, project budgeting and group leadership. I left the course with a detailed yet broad ranging knowledge of both rice research and production. I feel it would be difficult for me to attain the equivalent level of knowledge and opportunities that was presented in this course outside of the IRRI Rice Research to Production training," said Brooke.

"This course was a fantastic opportunity and I cannot thank the Crawford Fund enough for offering such a generous scholarship. It provided a high intensity, engaging learning environment that anyone interested in rice production would benefit from attending. I gained many different insights in rice research but more than anything, gained a great appreciation of the important role agricultural science plays in improving global food availability," she concluded.

Understanding Antibiotic Resistance in the Pork Food Chain in Vietnam

Marisa Mitchell, University of Sydney

In June 2018 Marisa moved to Vietnam to complete a 12-month Australian Volunteer assignment working with the International Livestock Research Institute (ILRI) under the Australian Volunteer government program. Simultaneously, she completed her Master of Health Security (agrosecurity) dissertation with support from the Crawford Fund Student Award. The dissertation contributes to the ACIAR-funded SafePork project (LS/2016/143), an ILRI-managed research project with Vietnam partner organisations.

"My project aimed to increase our understanding of the challenges to investigating antibiotic resistant foodborne bacteria along the pork-value-chain and the opportunities to strengthen a One Health approach to surveillance of antibiotic resistance in Vietnam," said Marisa.

According to the WHO, 'One Health' is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes.

Globally, antibiotic resistance is threatening human and animal health by reducing our ability to treat diseases and by causing complications to medical procedures. The environment, public health care sector and animal health sector are all considered to be contributing to the development of resistance. In low-and middle-income countries, the health threat is of even greater concern due to poor access to health services, the high burden of infectious disease in the general population, and the comparatively uncontrolled use of antibiotics in healthcare and food production.

"Vietnam is a potential hot spot for the emergence of antibiotic resistance due to the high burden of infectious and foodborne disease coupled with relatively unregulated access to antibiotics for humans and high antimicrobial usage in livestock. In food animal production systems, antibiotics are employed to treat infectious diseases, as growth promotants to increase productivity or as a preventative health measure. The level of foodborne antibiotic resistant bacteria is currently unknown due to the lack of a sufficient surveillance system," said Marisa.

"Although antibiotic resistance is a natural biological phenomenon, there are cultural, political and economic processes that shape the dynamics of these biological mechanisms which can determine its impact on the health of animals, humans and the environment. Due to the complexity of antibiotic resistance, a One Health surveillance system for antibiotic resistance is strongly advocated by the international community."

As part of the research project, Marisa undertook interviews people working across the human and animal health sectors in Hanoi.

"With the assistance of The Crawford Fund via the Student Award Scholarship I was able to travel around Hanoi, Vietnam, scope out with whom I need to speak and begin to understand more about the situation in country. Spending time in Vietnam and talking with local professionals provided me with a greater understanding of the situation on the ground and what other challenges the country faces when trying to tackle antibiotic resistance. With the support of the grant I had the flexibility and time to adapt the research objectives to better align with the local context", said Marisa.

"Using qualitative methodology, I conducted 11 semi-structured interviews with a total of 12 key informants working across the animal health (8; 2 men and 6 women) and human health (4; 3 men and 1 woman) sectors in Hanoi. The recorded interviews were conducted in English or Vietnamese with an interpreter, then transcribed and translated for analysis. Thematic analysis of the data was employed to generate themes to determine the challenges and constraints in investigation processes and participant perspectives on a One Health approach to antibiotic resistance surveillance."

"As a student researcher working in a middle-income country for the first time I really wanted to make sure I could relay the participants' perspectives and insights accurately. Without the assistance of the Crawford Fund Student Award I would not have been able to have the interviews transcribed and translated from the recorded interviews. Although I had a translator during the interviews, I found that having a transcript of the interviews provided me with the ability to analyse the data in greater detail and discover information which was not immediately recognised during the interviews."

The Student Award also funded Marisa's visit to Ho Chi Minh City, Vietnam, to attend a One Health and Microbiology Conference and present a poster entitled 'Identifying the constraints and/or opportunities in a One Health surveillance system for antibiotic resistance in Viet Nam' (Mitchell et al. 2018).

- The key findings from Marisa's study suggest that, participants perceive that:
- the use of antibiotics within animal food production systems is a key driver of antibiotic resistance in human health in Vietnam;
- there is divergence of opinions on laboratory capacity by sector and discipline; and,
- there is insufficient data available and data sharing between sectors.
- This study found that a One Health approach is favoured by participants working on antibiotic resistant projects across the human and animal health sectors. The data gathered helps strengthen evidence required to deliver policy decisions that will facilitate effective and efficient implementation of a One Health approach to antibiotic resistance surveillance in Vietnam.

Australian Volunteers Program participant Marisa Mitchell talking with pork retailer Nguyen Minh Thi at Thanh Cong market in Ba Dinh, Hanoi. Photo credit: Le Bao Minh Hien (TAJ media).

"The knowledge I have gained from this project has strengthened my understanding of One Health and my belief that to tackle global issues such as antibiotic resistance, further consideration of building and strengthening effective collaboration between the human health and animal sectors is needed. The issues and concerns raised by stakeholders in Vietnam are applicable in Australia as well as many other countries who are developing their understanding of how to tackle antibiotic resistance."

"I would like to express deep gratitude to Associate Professor Jenny-Ann, for her guidance and support in the

development of this research idea and Professor Robyn Alders for her comments, encouragement and inspiration. I have been incredibly fortunate to have had two immensely knowledgeable mentors to guide me through writing this dissertation."

"I would also like to thank in-country advisors from the International Livestock Research Institute, Dr Fred Unger and Dr Hung Nguyen-Viet. I am truly grateful for their warm welcome in Vietnam, their generous support and for widening my understanding of the research topic in Vietnam. Additionally, I would like to thank the SafePork team, especially Dr Sinh Dang-Xuan and Dr Pham Duc Phuc for their insights into the human health sectors and the staff at ILRI Thanh Nguyen, Thinh Nguyen, Chi Nguyen, and Hanh Le."

"I would like to thank the participants of this project who generously gave up their time and provided their insight. I would like to acknowledge the main donors of my research project; the Crawford Fund, ACIAR, and the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH)."

Contributing to Production and Biosecurity – Cattle and Buffalo in Cambodia

Luisa Olmo, University of Sydney

University of Sydney student, Luisa Olmo, travelled to Cambodia and Hong Kong, in connection with an ACIAR project as part of her Student Award experience.

"I travelled to Cambodia and Hong Kong to collect and analyse cattle and buffalo serum samples for reproductive pathogens thanks to the Crawford Fund Student Award," said Luisa Olmo, a third year PhD student investigating reproductive efficiency in smallholder cattle and buffalo in Laos and Cambodia, with the Mekong Livestock Research Team at the University of Sydney.

"In 2016, our team screened 160 Lao cattle and buffalo serum samples for reproductive pathogens potentially causing reproductive failure, facilitated by the College of Veterinary Medicine and Life Sciences (CVMLS) at the City University of Hong Kong," said Luisa.

The preliminary analysis revealed 70% seroprevalence of Neospora caninum in buffalo and exposure to Leptospira interrogans serovar Hardjo and bovine viral diarrhoea virus (BVDV) in cattle which were most prevalent in provinces heavily involved in provincial and cross-country trade. With similar risk factors being present in Cambodian smallholder livestock systems, a similar investigation was deemed essential.

"We received permission from the General Directorate of Animal Health and Production (GDAHP) to export stored serum samples from Cambodia in March. Although the task in Cambodia was wrought with uncertainty, I had a lovely stay in the warm and bustling city of Phnom Penh, enjoyed pleasant lunches with the team, and eventually navigated through the lengthy customs procedure," said Luisa.

"At the City University of Hong Kong I worked in the brand new Veterinary Diagnostic Lab (VDL) learning how to conduct enzyme-linked immunosorbent assays under the supervision of Postdoctoral fellow Dr Lloyd Wahl, and during my stay we analysed 500 samples for antibodies against N. caninum, BVDV and Brucella abortus revealing an overall seroprevalence of 9%, 6% and 0%, respectively," she said.

This analysis is essential to understanding possible disease causes of reproductive inefficiency, which is problematic in smallholder production. Baseline data and investigations are needed to prevent disease transmission; and to improve reproductive efficiency.

The testing of these pathogens would not be currently feasible in Laos and Cambodia where research resources are still being developed and priority is given to Foot and Mouth Disease and nutritional investigations.

"I also had time to develop and strengthen relationships with academics and students at the CVMLS. I discussed the results first hand with Dean of the CVMLS, Professor Michael Reichel who arranged for me to meet the Chair Professor of One Health, Professor Dirk Pfeiffer and gain his insights into One Health and developing country research," she said.

"I presented a 30 minute seminar to the Centre for Applied One Health Research and Policy Advice and the university posted a news article on its website. This seminar led to discussions with Associate Director of the CVMLS, Dr Richard Brown regarding potential future work on trace elements. Working in the VDL also enabled me to meet with Dr Vidya Bhardwaj who shared her insights on her previous work in Laos," she said.

"The trip proved to be a valuable learning and networking experience that established new research protocols between institutions and determined baseline prevalence data in Cambodia. I am now statistically analysing the results to determine trends that will hopefully contribute to biosecurity knowledge in the region," concluded Luisa.

Luisa presented her research findings, "Investigation of infectious reproductive pathogens of large ruminants: are neosporosis, brucellosis, leptospirosis and BVDV of relevance in Lao PDR?" at the recent 30th World Buiatrics Conference held in Sapporo, Japan.

Getting Stuck into Rice Research and Production

Rachael Wood, University of Sydney

Thanks to The Crawford Fund NSW Committee, Charles Sturt University student, Rachael Wood travelled to the Philippines to undertake the International Rice Research Institute's (IRRI) Rice Research to Production course.

IRRI's Rice Research to Production course in Los Banõs, The Philippines brings together scientists with different backgrounds from around the globe.

"The course was the perfect balance between classroom lectures, laboratory visits, free time and getting knee deep in mud. Within the second day of the course, I had the most memorable experience of learning to plough a rice field using a carabao, a domestic buffalo native to the Philippines," said Rachael.

"Other field work included hand transplanting week-old rice seedlings into thick mud. Gaining an understanding of traditional methods in rice production made me appreciate how hard-working Filipino, and other Asian rice farmers truly are," she said.

As part of the course, participants had the opportunity to visit and interview local rice farmers, where they were impressed by the commitment of farmers to use minimal inputs and stay well connected to technology and the latest research results from IRRI.

"During the weekends we got to visit the beach and also the breathtaking rice terraces of Banaue. During our visit to Banaue, a few of us opted to hike among the thousand-year-old rice terraces which was an incredible experience, despite being utterly wet from head to toe," said Rachael.

"My PhD research involves rice quality, and it was great to gain insight into different techniques used for assessing quality. One of my primary motivators in applying for the course was to understand the genetic side of rice research further. Getting to perform panicle crosses and visiting the glass houses and transgenic laboratory helped to enhance my knowledge in rice breeding."

"It was clear that everyone at IRRI is working towards a common goal of trying to address global food security and improving the lives of rural farmers. Taking part in their course has made me want to continue to be involved in agricultural research, particularly in an important food source such as rice. The course facilitator, Dr Joshua Cobb, was very passionate about addressing the future global food scarcity and it was hard not to walk away inspired," she said.

At the beginning of the three weeks, everyone talked about how the relationships formed would be the best part about the course. And it may sound like a cliché, but I genuinely made some lifelong friends, and I look forward to future conferences where we can reunite," she concluded.

NORTHERN TERRITORY

Building Enterprise in the Pearl Industry for Women in the Pacific

Samantha Nowland, NT DPIR & Sunshine Coast University

Samantha Nowland undertook a two-week study tour of Tonga and Fiji to visit women's groups involved in the Australian Centre for International Agricultural Research (ACIAR) project "Developing pearl industry-based livelihoods in the Western Pacific."

This project builds on past ACIAR research and aims to strengthen collaborative research supporting pearl industry-based livelihoods in Tonga and Fiji and involves many technical aspects of mabé pearl (half pearl) culture and production. The Pearl Livelihoods Project has been successful in developing economic opportunities for women in Tonga and Fiji and Samantha's study tour focused on the engagement of women in community-based pearl farming and handicraft production.

"The aim of my study tour was to gain hands-on experience and insight into how the project achieves both social and economic success with a focus on how the project works with women's organisations and, through direct engagement with local women to increase understanding of how they operate," said Samantha.

"I also hoped to gain an understanding of how the Pearl Livelihoods Project overcomes the challenge of engagement obstacles, including implementing an economic development project in remote rural areas."

ACIAR pearl projects (including round commercial pearl farming) have been running (not without breaks) for about 20 years in Tonga and longer in Fiji. Women's engagement is strong throughout the Pearl Livelihoods Project and their inclusion is clearly part of the project design. In Tonga, women's leadership is strong in the fisheries agencies, where women occupy a number of the senior roles, including the Manager of Aquaculture and two heads of regional Fisheries offices (they look after both Fisheries and Aquaculture), and generally, pearl farming is primarily a family run business.

"We met two women farm owners, Anna ('Big Mumma' as she calls herself) and Moa, and all farms (17) had women involved in post-harvest processes such as carving, marketing, and sales. Women who do not have family mabé pearl farms are also indirectly involved in the Pearl Livelihoods Project. For example, we met a woman named Manaseu who does not own a mabé pearl farm but is a talented carver. Manaseu buys mabé pearls and raw pearl shell from local farmers to create jewellery for her stall at the handicraft markets. She was happy that the project was supporting the farmers to supply her with raw material to carve, as the demand is high for local handicrafts during the peak tourist season (May-October)," said Samantha.

"We also met Sophie and Tracy. Sophie moved to Tonga in 2017 to work on the Pearl Livelihoods Project as an Australian Volunteer for International Development (AVID) for 12 months. At the same time Tracy, who is Tongan, worked for Fisheries as the Deputy Head of Aquaculture in conjunction with the Pearl Livelihoods Project. They worked together and became good friends. When we talked with them they reflected on being able to support each other's work and encourage each other to undertake higher education. This is a great example of women supporting each other to grow and learn, and of how the Pearl Livelihoods Project has been supportive of their development, supporting regional capacity building."

In Fiji the pearl farmers visited were more geographically remote than those in Tonga, with drives on dirt roads for hours in FWDs to reach some of the villages. In these remote villages the women prefer to work collaboratively in pearl farming and handicraft activities as members of formal women's groups.

"We visited both the Ravita Women's Group and Raviravi Women's Group and both groups included almost all the adult women of the village. There are more obstacles for farming in remote areas, nevertheless it became clear that the more remote you go, the bigger the benefits to women's lives. An initial key obstacle for the women to engage in pearl handcraft is the lack of mains power in the villages, only a generator that is expensive to run. This makes carving the jewellery from pearl shells very difficult. The project has overcome this obstacle by supplying hand tools

and training for grinding, carving, and polishing the shells by hand. The jewellery they make is impressive, high quality and is the result of long hours of work. An alternative for those women's groups that have too much shell to carve themselves, is to sell the mabé pearls and raw pearl shell to a different women's group in town, who have access to power tools but not shell."

This group is called MSF (Marama Shell-craft Fiji) and was established as part of the Pearl Livelihoods Project. Samantha visited the 10 women members of the MSF at their workshop in the town of Ba, Viti Levu. To be part of MSF the women must undertake a year of training to learn handicraft skills and an overseas trainer is regularly brought in by Pearl Livelihoods Project to provide this training. In between the trainer-led workshops there was a lot of peer teaching and learning. The MSF women work three days a week, for eight hours a day.

"The women seem very happy to have a culturally appropriate way to socialise, learn new skills and earn some money," said Samantha. Further, children are also allowed to be there when the women work, which allows mothers and grandmothers who take care of young children to attend.

"Throughout the study tour I was able to see many learnings that could be applied to our Northern Territory Government's Tropical Rock Oyster Aboriginal Economic Development Project (NTG Oyster Project). In general, two things we can do better within NT Fisheries are: (1) employ more women in leadership roles within fisheries agencies, we do not do this nearly as well as either Tonga or Fiji; and (2) work more closely with local universities to enable student involvement," said Samantha.

A tool that has been effective in Tonga and Fiji that could also be applied to the NTG Oyster Project is to provide training as 'workshops' said Samantha. This workshop model provides support to communities by bringing in highly skilled trainers and avoids dependence, as the trainers are not part of the project full time.

"One thing we do well in the NTG Oyster Project is supporting different engagement models, depending on what each community prefers, such as: working with the local Aboriginal corporations, ranger groups, and individual family groups. The Pearl Livelihoods Project also does this well and on a bigger scale (more farms involved). It was encouraging for me to see that this approach is scalable and confirms that we are on the right track with the NTG Oyster Project," said Samantha.

In both Tonga and Fiji, the community groups have good governance and the villages receive assistance to develop Community Development Plans and are provided with governance training. This is a major head start in the development of small businesses for these villages, as it helps them to articulate their vision and set goals for their pearl farming enterprises. According to Samantha, this type of governance and planning support is something that could be applied to oyster farming business planning in remote Aboriginal communities, in the Northern Territory.

"The Crawford Fund Student Award allowed me great insight into how the Pearl Livelihoods Project continues to engage and support Tongan and Fijian women in community- based mabé pearl farming and handicraft. It is clear that there is much for us to learn from our regional neighbours that can be applied to our own rural development programs", said Samantha.

"In my opinion, key success factors of the Pearl Livelihoods Project include: long-term commitment, knowing how to get the right people in the right places, working well with regional government agencies, supporting the next generation of scientists through student involvement, supporting communities to overcome technical obstacles, ensuring flexibility in project design, and either working with groups that have good governance or supporting governance training within the project."

"Personally, the study tour was an invaluable life experience and I am excited to see how the women progress in their pearl enterprises. I will definitely be back to both Tonga and Fiji. There is nothing that can replace personal experience and I am so grateful that the Crawford Fund appreciate this and enable overseas hands-on experiences, through this Award," she concluded.

QUEENSLAND

Exploiting the Banana Microbiome to Suppress Panama Disease in Indonesia

Henry Birt, University of Queensland (report pending)

Understanding the Role of Seaweed in the Samoan and Kiribati Diet to Boost Future Intake

Hayley Butcher, University of Southern Cross

Thanks to The Crawford Fund Queensland Committee, University of the Sunshine Coast student Hayley Butcher journeyed to Pacific Island countries as part of ACIAR research to stimulate economic development in local communities, while increasing sustainable food supplies through agribusiness development.

Hayley is a Bachelor of Dietetics (Hons) student who travelled to Samoa and Kiribati to look at the availability and consumption patterns of Caulerpa racemosa, a green seaweed, and provide insight into motivational factors for increased consumption.

Pacific Island countries, including Samoa and Kiribati, are currently experiencing a high incidence of diet related non-communicable diseases (NCD) which have coincided with a shift in diet from traditional, local food-based diets to a dietary pattern characterised by high fat, high sugar, imported foods.

As part of efforts to address NCDs, ACIAR have funded research which identified Caulerpa racemosa, a green seaweed from the genus Caulerpa, for its ability to be readily domesticated.

"Caulerpa grows natively in both Samoa and Kiribati, and could provide a culturally appropriate, nutritionally dense food source in these countries, and it has the potential to be exported, highlighting a potential for economic growth," said Hayley.

Currently, no literature exists in relation to the consumption behaviours of Caulerpa in any of the Pacific Islands. Hayley's study aimed to fill this gap, by quantifying consumption status and frequency, as well as identifying any potential associations between demographic factors and consumption and key motivators for consumption.

"The data collection took place in Apia, Samoa (n=79) and South Tarawa, Kiribati (n=66), and the results revealed that Samoan participants were significantly more likely to consume Caulerpa and consume it more frequently than those surveyed in Kiribati."

Other results included:

- No associations between age or gender and consumption were found.
- Taste and culture were primary motivators to consume Caulerpa amongst Samoan participants only. Importantly, the cultural significance of Caulerpa in Samoa may be upregulating its consumption (both consumption status and frequency).
- Ease of access is a motivator in Kiribati only, which may be due to the limited availability to fresh produce in the country.
- Both countries were motivated by health and price, with price particularly important as both countries identify as low-middle income countries.
- Taste as a greater motivator amongst the Samoan participants was attributed to their greater degree of food security, where food is consumed in the interest satiety but also enjoyment.
- The findings of this study are underpinned by the degree of food security and differences in culture in Samoa and Kiribati.

Future public health efforts will need to work within the existing social parameters in each respective country.

"This study provided baseline data, which provides further foundations which can be built upon by Queensland researchers at the University of the Sunshine Coast (USC). In addition, this project established a link between the Science Department and the Nutrition Department at USC, where further research opportunities have arisen in the space of nutrition in the Pacific Islands in relation to a variety of seaweeds," said Hayley.

"I would like to express a special thanks to those who assisted with this project. First and foremost, to Dr Libby Swanepoel, Dr Sarah Burkhart and Assoc Prof Nicholas Paul for their contributions to all stages of the project. In addition, Sapeti Tiiti, Taati, Kiribanang and Joseph Martin for their extensive support while in-country, as without them the data collection would not have been possible.

"I would also like to thank the funding bodies who made this project possible, including ACIAR, The Crawford Fund and the University of the Sunshine Coast," she concluded.

NextGen Working on NextGen Sequencing of Chickpeas at ICRISAT

Sonal Channale, University of Southern Queensland

Sonal Channale travelled to ICRISAT headquarters in Hyderabad, India from June to September 2019 to undertake research to identify root-lesion nematode resistance genes to help accelerate breeding for chickpea varieties resistant to the parasite, and thus contribute to increased yields, and ultimately increased profits for chickpea growers in Australia and other countries.

"With the help of the Crawford Fund Award, I was able to carry out part of my PhD work at one of India's pioneering institutes in agriculture, ICRISAT, which is a global leader in the field of genomics, molecular breeding and physiology of chickpea. Researchers at ICRISAT have contributed immensely to the conversion of chickpea from an orphan crop into a genomic resource rich crop using Next Generation Sequencing technology," said Sonal.

Chickpea (Cicer arietinum) is an important crop for Australian farming systems because it is a protein rich food, has a natural ability to fix nitrogen in soil for the crops grown in rotation and because of its export value. It is predominantly grown in the sub-tropical grain region of eastern Australia (central and southern Queensland and northern New South Wales).

However, chickpea productivity is affected by various pathogens. One such pathogen which feeds on chickpea roots is the worm-like parasitic nematode Pratylenchus thornei, known as root-lesion nematode (RLN). These microscopic nematodes cause lesions when they feed on host roots which results in the roots functioning less efficiently in the uptake of water and nutrients, and thereby affects the chickpea yield.

Most chickpea cultivars grown commercially in Australia are susceptible to P. thornei, resulting in yield losses of up to 20%, a significant reason to search for approaches to improve genetic resistance to RLN in chickpea. Pratylenchus thornei is a soil-borne pathogen, so it is difficult to eradicate it completely from infected fields. Current methods to control RLN infestation rely on integrated management strategies, including crop rotation and the use of tolerant and resistant cultivars.

"The approach undertaken in my study to protect chickpea from nematode attack was to identify candidate genes (key factors) for resistance to P. thornei using Next Generation Sequencing (NGS) technology and bioinformatics. NGS technology refers to the platform used for sequencing DNA and RNA molecules, which essentially refers to obtaining the blueprint of an organism. Bioinformatics is an interdisciplinary branch of science which uses software

and tools to understand the biological data."

The outcome of this study will help to improve the farming systems in Australia and other countries facing similar issues. It is imperative to address this issue, as Australia ranks first as chickpea exporter in the world and if the issue remains unaddressed, yearly losses of $18 M are forecast.

"The experimental design for the research that I conducted at ICRISAT involved challenging different chickpea lines with RLN in replicated glasshouse pot experiments, microscopic investigation of nematode infection and reproduction over time, followed by RNA profiling (using NGS technology) and bioinformatics. From this study I have been able to identify the difference in plant response between RLN resistant and susceptible chickpea lines at the genomic level," said Sonal.

"I fully embraced the opportunities that the Crawford Fund Award provided me as a student with respect to building international ties, exchanging and enriching knowledge," she said.

The outcomes of the study will be used for further development of markers which will act as diagnostic tools for the large-scale screening of RLN resistance sources and facilitate marker-assisted breeding for RLN resistance in chickpea. The development of molecular markers for RLN resistance genes will be valuable tools to assist chickpea breeding programs, not only in Australia but around the world wherever RLN is a threat to chickpea crops, to incorporate resistance into existing elite varieties.

"To the best of our knowledge, this study is the first attempt to address the RLN issue in chickpea with help of genomics and bioinformatics" said Sonal.

"This collaborative project strengthens the research links between University of Southern Queensland, Australia and International Crops Research Institute for the Semi-Arid Tropics ICRISAT, India. The knowledge generated from this project will foster ongoing Queensland – India engagement, as P. thornei is emerging as a serious threat to chickpea production in India."

"I am grateful to the Crawford Fund as the platform for enabling me to develop the necessary skills to use various software and tools for bioinformatics data analysis. With this unique opportunity I was able to work in international environment and was able to interact with students and researchers working on different aspects of agriculture sustainability and market policies," she concluded.

Sonal also acknowledged the International Stipend & Fees Research Scholarship from the University of Southern Queensland, and ICRISAT for their assistance with this project.

Sonal's project also resulted in the publication of a journal article – Zwart, R. S., Thudi, M., Channale, S., Manchikatla, P. K., Varshney, R. K., & Thompson, J. P. (2019). Resistance to Plant-Parasitic Nematodes in Chickpea: Current Status and Future Perspectives. Frontiers in Plant Science, 10.

India and Australia – Sharing Knowledge for a Sustainable Future

Daniel Cruz, University of Queensland

Daniel Cruz travelled to India between February and April this year to undertake fieldwork and gather information about the history, practices and achievements of Navdanya, a well-known a capacity-building and agro-ecological research organisation working with small and marginal farmers in India.

In the field, Daniel conducted participant and non-participant observations during intensive training sessions, in which researchers, farmers and community leaders received and put in practice the agro-ecological technical knowledge gathered by the local researchers. Semi-structured interviews were also developed after conducting a stakeholder analysis which allowed to identify three main types of participants, namely farmers, community trainers and professional staff. Finally, Daniel undertook a document analysis.

The findings were shared with key stakeholders in Queensland and India.

"Navdanya was chosen for this study because of its reputation of a long and successful history of impact. During the last 30 years it has been removing the barriers that prevented farmers to be self-reliant and able to exercise agro-ecological farming," said Daniel.

Navdanya's research and work has trained one million farmers, has supported the restoration of two million acres of land, is conserving 2500 varieties of crops (including 700 varieties of rice and 205 of wheat), has established 127 community seed banks and has instituted the largest direct marketing, fair trade organic network in India.

"Because of Navdanya's impact, my project aimed to collect data about the organisation's work and then facilitate the creation of a knowledge-sharing network between the academic and organic agriculture sectors in Australia and India," said Daniel.

On one hand, Navdanya has become a globally renowned best-practice experience in organic farming and on the other hand, Australia is the nation with the highest organically farmed land area worldwide, with Queensland alone representing a fifth of that market.

The main limitation to meet the increasing demand in Australia is the transition process from conventional to organic, which takes a minimum of three years. After 30 years of experience, Navdanya's knowledge can inform Australian farmers how to be more effective in the organic transition.

"Through this project I learnt that the main goal of organic farming is to enable farmers to become self-reliant and to be able to mitigate and adapt to climate change. I was told how organic farming brings ecological resilience, empowerment, sustainability and economic self-reliance to farmers through the protection of climate resilient

varieties, the focus on diversity of seeds and crops, the recycling of biomass and nutrients, the protection of soils from losses and the enhancement of biological interactions," said Daniel.

"My experience in Navdanya's centres enabled me to understand the importance of agro-forestry systems, mixed farming, cover crops and crop rotations, as well as the importance of forest management and livestock to provide inputs for sustainable agro- ecological systems. I also learnt about soil testing methods and techniques to promote soil health and the role of composting, organic manuring, mulching and mixed cropping."

The processes of transition from chemical based farming and organic farming were also shared, as well as the importance of monitoring soil conditions during the process.

"I was also able to visit the community seed banks and learn about practices of seed conservation and management and the importance of saving seeds and the role of saved seed for relief actions conducted by Navdanya after floods and earthquakes happened in India, Nepal and Indonesia."

"Finally, I learnt how Navdanya set up a fair-trade scheme based on the principles of social-environmental justice which benefits farmers, consumers and ecosystems by promoting the conservation of biodiversity, economic and social justice, the protection of intellectual property rights, self-reliance, decentralisation, women empowerment, and apart from that provides healthy, diverse and nutritious foods," said Daniel.

"After engaging in interviews with the key stakeholders I understood that the essential element of the success of Navdanya is to empower farmers to embark in the transition towards organic farming is capacity building and community organising," said Daniel. The capacity building approach of Navdanya is based on a participatory approach which differs from the usual extension model of agricultural development projects.

The model works in this way: after the training, which is mostly practical due to the low levels of literacy in the regions, farmers were given native seeds, and a plot of land was voluntarily allocated by themselves to grow those seeds and apply the new methods learnt. In this way, farmers were able to compare the benefits of organic farming in relation with chemical-based farming in their own plots. Such an approach had a massive success because farmers could experience themselves the benefits of organic farming in terms of economic self-reliance and sustainability, livelihoods, culture, health and environmental conservation. Such benefits led farmers to shift to organic. In addition, Navdanya experts and community trainers are constantly available to assist farmers.

Navdanya now has a network of farmers active in influencing the government to support organic farming and small and marginal farmers. Furthermore, with the support of donors the organisation has been able to establish a system in which the organisation collects the organic produce from farmers directly at their farms and pays them 10% higher price based on the local markets price.

This project has delivered benefits to India, international agriculture and to Queensland.

"I shared the experience of Navdanya with The Deccan Development Society in India which has worked for 25 years empowering women from 75 villages in seed saving, agro-ecology, community radio and political participation for food sovereignty and also has a fair-trade scheme based at the local level. Now both organisations are in contact and will be exchanging knowledge."

"I also supported communication between Navdanya and Food-Connect, a network of farmers and consumers based in Brisbane which works under the principles of community-based agriculture and solidarity economies. Food Connect has set up a market strategy based on the above principles and will be able to guide Navdanya on how to improve their own strategies."

"Taking into account the need of the agricultural sector in Queensland to learn from innovative methods useful to escalate the organic transition and keep up with the increase of the market demand for organic produce, I acted as a bridge between Navdanya and several organisations and individuals in Queensland. As a result, I delivered presentations to groups of students and experts of the School of Social Sciences, the School of Communication and School of Agriculture and Food Sciences from The University of Queensland." Said Daniel.

"I also connected the directors and staff of Navdanya with experts of The University of Queensland working in the development sector related with agriculture and social-environmental justice."

"Furthermore, I shared some of the things I learned with representatives from community gardens as well as with representatives from The Gap Loco Cooperative in Brisbane. I also engaged in communications with representatives from organic certifying organisations approved by the Department of Agriculture, such as AUSQUAL, ACO, OFC, SXCA."

"Finally, I was able to share some of my experiences from this research with permaculture and syntropic farming experts based at the Gold Coast, the Sunshine Coast and Coopers Plains in Brisbane."

"I would like to express my gratitude to The Crawford Fund for providing me with the support and resources necessary to conduct this research project. I also would like to offer special thanks to Dr Vinod Bhatt, Dr Ashok Kumar Panigrahi, Dr Kusum Misra, Mr Chandra Bhatt and Dr Vandana Shiva. I am grateful to all the farmers and community trainers associated with Navdanya and also to my advisors Dr Lynda Shevellar and Dr Elske van de Fliert. Lastly, I would like to express my gratitude to Professor Bob Lawn and Cathy Reade from the Crawford Fund for their guidance and support during the development of this research."

Understanding Genetic Diversity for Sea Cucumber Conservation in Vietnam and Australia

Chieu Hoang Dinh , University of Southern Cross

As part of his project, "Analysis of genetic diversity for sea cucumber conservation in Vietnam and Australia," the first comprehensive study to investigate genetic diversity in sea cucumber H. leucospilota using single nucleotide polymorphisms (SNPs), Chieu Hoang Dinh analysed tissue samples of sea cucumbers collected from five locations in Australia and Vietnam in 2018. Genetic sequencing and data analysis were undertaken, with the results now available to guide future restocking, management, conservation and captive breeding initiatives.

"Sea cucumber, Holothuria leucospilota, is being overfished, which has led to the rapid exhaustion of wild populations. Analysis of population genetic diversity of natural populations is, therefore, necessary for the restoration and management of wild populations, and to avoid inbreeding in aquaculture," said Chieu.

Sea cucumbers are commercially valuable due to their high demand for human consumption and usage as traditional medicines. At present, wild-caught sea cucumber cannot meet the growing demand in Asia and internationally. The black sea cucumber Holothuria leucospilota represents an excellent alternative choice for people who prefer low fat diets because it has high nutritive values: high level of protein and carbohydrates as well as the lowest level of total lipids.

"Since natural stocks have decreased, government-operated stock release programs have been implemented. Analysis of population genetic diversity of wild and hatchery stocks is, therefore, necessary for the restoration and management of wild populations, and to avoid inbreeding in aquaculture populations," said Chieu.

"Due to the exhaustion of natural sea cucumber resources, artificial breeding has been implemented in Vietnam to produce high quality seed for aquaculture, stock enhancement and sea ranching, however, the large-scale artificial breeding and juvenile rearing has not yet been developed. To achieve this, a better knowledge of the reproductive characteristics and population genetics are required. Analyses of population structure and genetic diversity of black sea cucumbers are critical for the establishment of technical guidelines for resource management and selective breeding in Vietnam," said Chieu.

Body wall tissue samples of sea cucumber were collected from three regions in Vietnam and two locations in Australia. The three regions in Vietnam were Co To Island (North of Vietnam), Ly Son Island (Middle of Vietnam), and Tho Chu Island (South of Vietnam). In Australia, the samples were from Mooloolaba, Queensland and Darwin, Northern Territory.

An average of 36 samples were collected at each location. The biological information of total weight, gutted weight, gonad weight, gonad development stages, and gender was collected for quantitative analysis.

The results indicated that there was substantial genetic variation within a population and inbreeding level was low in all populations. The effective population sizes, which ranged from 94 to 141 breeding individuals, provides useful information for resource managers to develop restocking plans. Nei's genetic distances revealed that the genetic divergence was large between Darwin (Northern Australia) and other sea cucumber populations studied. Bayesian genetic cluster analysis showed that Darwin population could be a mixing of two previously isolated populations and was separated into a different cluster. This result should be used to assess the marine barriers, Palaeoecological history (e.g., glaciations) and oceanographic processes, which may have had a role in shaping the genetic variability and population structure of the sea cucumbers.

Collectively, the results from this study provide baseline genetic data to design a restocking management plan, conservation initiatives and captive breeding programs for sea cucumber populations in Vietnam and Australia.

"A concerted effort from different institutions enabled the large-scale collection of sea cucumbers from diverse geographical regions in Vietnam and Australia. This also helped to strengthen the collaborations between the Vietnam Research Institute for Marine Fisheries and University of the Sunshine Coast, Tasmanian Seafoods Pty. Ltd. and the Darwin Aquaculture Centre for potential future research in sea cucumber species," said Chieu.

"The achievements of this project will bring commercial benefits to both Australia and Vietnam institutions/ hatcheries, where the Australia institutions will transfer molecular genetic and hatchery technologies to Vietnam in order to develop the sea cucumber aquaculture sector and genetic conservation," he said.

"I would like to acknowledge the financial support of the Crawford Fund and laboratory facilities provided by the Genecology Research Centre, University of the Sunshine Coast (USC), Australia. I also express my deep gratitude to Prof Wayne Knibb, Dr Nguyen Hong Nguyen, Prof Abigail Elizur, A/Prof Scott Cummins and Dr Ajith Premachandra for their supervision and support from the original proposal to the project's conclusion," said Chieu.

"I extend my thanks to researchers of Research Institute for Marine Fisheries for their assistance in sample collection and dissection in Vietnam. My project was supported by USC-VIED PhD scholarship, a joint initiative between the Ministry of Agriculture and Rural Development, Vietnam and USC, Australia."

An article on this research published by the University of the Sunshine Coast is available here, and the project's findings will be reported in a research paper "Genetic diversity and population structure in sea cucumber H. leucospilota in Australia and Vietnam", later this year.

Understanding Coastal Livelihoods for Greater Impact in Timor-Leste

Ruby Grantham, James Cook University

Ruby Grantham travelled to Timor-Leste to undertake the seasonal livelihoods survey project ("The Livelihoods Project"), as part of an ongoing project aimed at providing a more complex and dynamic understanding of the role of fisheries in livelihood strategies in coastal communities.

"The Crawford Fund Student Award enabled a panel design survey to be implemented by local data collectors, which generated higher quality and more detailed data than cross-sectional surveys that rely on recall," said Ruby, a PhD candidate at the Australian Research Council Centre of Excellence for Coral Reef Studies, at JCU.

"It also provided an opportunity to train and employ local women which improved community engagement and provided direct benefits to the study communities," she said.

Timor-Leste is one of the world's hungriest countries. Food insecurity and malnutrition are a key challenge. According to data from 2012-2016, it had the highest rate of child stunting globally (50.2%) and was ranked 110 out of 119 countries in the global hunger index in 2018.

Food insecurity in Timor-Leste is characterised by an annual lean season where shortages in staple crops, often forces households to adapt their livelihoods and draw on coping strategies. Dependency on rainfed subsistence agriculture, low crop production, and poor infrastructure result in widespread food shortages in the months leading up to the main harvest. The lean season is particularly acute in rural areas. Livelihood dependency on subsistence agriculture and the associated food insecurity reflect Timor-Leste's underdevelopment, which is in part, the legacy a long history of colonisation, instability and conflict.

"Improved food security in Timor-Leste will require a better understanding of livelihood strategies, how and why they vary seasonally," said Ruby.

"This information would help policy to reconcile economic development, environmental protection and the needs of local communities. Coastal communities are often some of the most vulnerable to environmental and socio-economic changes, which can have significant implications for local livelihoods and human well-being."

The Livelihoods Project was carried out in two coastal communities on Atauro Island, Timor-Leste. Both study communities are protestant and have populations of roughly 120 people. The communities have similarly low levels of economic development, there are few income earning opportunities and livelihoods are predominantly subsistent. Small solar panels used to power light bulbs are the only source of electricity for most households.

The survey collected daily household data on livelihood activities, incomes, expenditures and consumption, and it was implemented by local data collectors following a panel design. Preliminary findings show that livelihoods on Atauro are a dynamic patchwork of activities structured to smooth income and consumption fluctuations. Livelihood dynamics are shaped by seasonal cycles in the weather and sea conditions that determine fishing and farming activities.

"The findings of The Livelihoods Project support improved coastal management strategies and are relevant to food security, development and conservation policy in Timor-Leste," said Ruby.

The project's data collector roles were offered to women only. Women are often more aware of household livelihood activities and consumption than men and women are typically more comfortable talking to other women, so women were employed as data collectors to increase the likelihood of survey respondents being women. Further, women have fewer income earning opportunities, so employing women was a means through which The Livelihoods Project was able to have a direct and positive impact on the participating communities.

A total of 1422 household surveys were undertaken for the project. A majority of the surveys focus on the core panel of 30 household who were surveyed every day during the six survey weeks. The level of detail captured by the data provides important insights into the dynamics of household livelihoods and the analysis of this huge dataset is ongoing, with these findings preliminary and unquantified.

The three main livelihood activities on Atauro are crop farming, livestock and fishing, each of which serve a different livelihood purpose. All households in the study communities farm staple crops including corn, peanuts, various types of bean, pigeon pea and pumpkin in small fields. The crop farming cycle is determined by rainfall. Crop farming is almost an entirely subsistence activity and households only very occasionally sell crops. A majority of harvest is dried

and stored to be eaten as the main source of household food for the year. The success of the yearly harvest and the quantity of staples crops that a household is able to store is a major determinant of household food security and the severity of the lean season.

Livestock are kept predominantly as a form of insurance by households and most households own a small number of pigs, goats and chickens. Livestock can be sold for a relatively high price and can therefore provide a source of income in an emergency and to purchase food during the lean season. Livestock are only eaten on special occasions, such as weddings and church events.

Fishing activities and fish catch, and therefore the contribution of fishing to livelihoods, are highly dependent on sea conditions which are determined by the seasonal winds, geographic location of fishing areas, and the effect of the lunar cycle on tides and fish behaviours.

During the calm season most fishers go on at least one fishing trip a day. Catches in the calm season are high, and fish is eaten fresh, stored (dry), given away to other households and sold (fresh and dry). Comparatively, when sea conditions are bad many households do not go fishing at all, sometimes for weeks at a time. Catches in the bad season are usually small and therefore only used for household consumption. Poor sea conditions not only limit fishing, but market access as well, making it difficult for households to earn income and purchase food.

Dietary diversity is highest during months when good sea conditions and crop harvests coincide and lowest when bad sea conditions coincide with the lean season.

"Understanding livelihood structures is important for reconciling the needs of people with environmental protection and better coastal management. The findings from this project are therefore relevant to development, food security and conservation policies," said Ruby.

"The detailed consumption data collected can be used to assess nutrition and identify seasonal shortcomings in individual and household diets, and to inform more effective food security strategies and support better health and consumption decision-making in households," said Ruby.

"This project was successful because of the partnerships it has developed and utilised," said Ruby.

James Cook University is recognised globally for producing high quality and high impact marine research. Timor-Leste, as one of the world's marine biodiversity hotspots and being relatively accessible to Queensland, has the potential to be an important research site for JCU, and the seasonal livelihoods project was implemented with on-the-ground support from WorldFish Timor-Leste, therefore strengthening research partnerships between Queensland and Timor-Leste.

"The high standard of The Livelihoods Project is a result of the combination of academic expertise from JCU and the local expertise of WorldFish Timor-Leste," said Ruby.

"The Livelihoods Project enabled by the Crawford Fund has provided many benefits to me. From a professional perspective, the experience of developing and managing a locally implemented survey has developed my research design and fieldwork skills. The quantity and quality of the data collected has strengthened my PhD research project."

"From a personal perspective, I feel very privileged to have had the opportunity to work so closely with the communities of Akrema and Adara. I learnt a huge amount about life, society and history in Timor-Leste through the stories that the people shared with me. I developed good friendships with many of the community members and I was humbled by their generosity and kindness."

"The Livelihoods Project has been dependent on the support and engagement of many people. The project would not have been possible without the patience and generosity of the research assistants who translated and facilitated training and community engagement, the village chiefs who permitted and supported the research activities, the data collectors, who invested a huge amount of time and effort to learn and implement the surveys, and the households who participated so dedicatedly. The project was far more successful and enjoyable as a result of the continuous kindness and wisdom of the staff at WorldFish Timor-Leste."

"I am also very grateful to my three PhD supervisors, Graeme Cumming, David Mills and Cristian Rojas who have provided me with intellectual and financial support. Finally, I would like to acknowledge Natalia da Costa. Natalia was one of the original 6 data collectors and her hard work and friendship were very important to the success of The Livelihoods Project. Natalia sadly passed away in late February 2019 due to complications with a still birth. Natalia was a wonderful young woman, she was a kind and gentle wife and mother of two, and a keen gardener with a huge smile," she concluded.

Climate Change and Resilient Small-Scale Fisheries

Jacqueline Lau, James Cook University

Jacqueline Lau travelled to WorldFish headquarters in Penang, Malaysia and a WorldFish research station on Nusatupe, The Solomon Islands in March 2019 to investigate co-management approaches of small-scale fisheries in Asia as part of an ACIAR-funded project.

In Penang, Jacqueline presented a talk that combined her PhD research on access to ecosystem services in Papua New Guinea, and a broad introduction to current thinking and approaches to climate change in small-scale fisheries. Secondly, as part of the Fish Learning Hour, she spoke with WorldFish staff key questions about climate change and WorldFish research. Key questions included: What are the climate change research gaps across different contexts and food systems? How is climate change being addressed or integrated into wider research?

Finally, she was shown the current WorldFish database which compiles recent literature on the outcomes of co-management in SSF in Asia which she will utilise for a future literature review.

Jacqueline's initial intention was to undertake a systematic review of academic literature, grey literature, and case studies identified through expert elicitation to analyse current practices and outcomes of fisheries co- management in developing countries however due to changing circumstances this plan was revised, and, will become part of a future research project.

While, in Nusatupe, she participated in a workshop on 'Visioning for a Learning Hub' led by the Solomon's WorldFish office and contributed to discussions about current research projects on scaling co-management in The Solomon Islands, and on gender and participation.

"Both of these trips provided experiences and connections that I would otherwise not have been able to pursue as part of my PhD," said Jacqueline.

"This Award has allowed me to meet a range of WorldFish colleagues and begin to develop my future research plans, grounded in a better understanding of the issues facing small-scale fisheries," she added.

Coastal small-scale fisheries (SSF) are vital for food security, poverty alleviation, and wellbeing but face the increasing challenges of increased demand for fish, environmental change (particularly climate change), and diverse and data-poor management capacity.

Meeting these challenges requires collective action by communities in concert with innovations in the way governments and development partners provide support and catalyse change. Community-based, co-management approaches are heralded as a powerful and scalable governance approach to strengthen coastal SSF for wellbeing, but there are key capacity and knowledge gaps, and lack of evidence of outcomes, best practice and key processes across different contexts and in the context of climate change.

To fill these gaps, WorldFish is partnering with the University of Wollongong, the Pacific Community and country partners. This ACIAR-funded project aims to contribute to sustainable, well-managed inshore fisheries underpinned by community-based and co- management approaches – drawing on and refining best practice in the region and beyond.

"Aligning with this project, my Crawford Fund Award activities helped me gain experience and understanding of key research topics and challenges in co-management in the face of climate change," said Jacqueline.

"Receiving a Crawford Fund Award allowed me to experience the rich and varied range of contemporary research in small-scale fisheries. The experience has been invaluable in broadening my understanding of pressing climate change research agendas in small-scale fisheries, and in connecting me to practitioners and researchers in Penang and the Solomon Islands," she said.

"I intend to further develop research into climate change resilient small-scale fisheries and co-management to be carried out in the Solomon Islands, and – keeping in mind the vision for a learning hub – that will be relevant to small-island developing states in Australia's region," she said.

In June 2019, Jacqueline took up a joint post-doc position with the ARC Centre of Excellence in Coral Reef Studies and WorldFish.

"The process of working with WorldFish to put together the Crawford Fund application and think through pressing research agendas, also no doubt helped me to successfully gain employment in the sector."

"I would like to thank the WorldFish staff who welcomed me so warmly both in Penang and The Solomon Islands. In particular Dr Philippa Cohen, Matthew Rosher, Delvene Boso and the staff in the WorldFish Penang, The Solomon Islands and Nusatupe offices," she concluded.

Exploring Difference for Mutual Benefit – Mungbeans in Myanmar

Thomas Noble, Queensland University of Technology

Mungbeans are an important export crop for farmers in Australia and Myanmar. Annually Australia produces an average of 100 000 tonnes compared with Myanmar's 340 000 tonnes. However, the production pipeline and constraints are vastly different between the two countries. Exploring these differences was an important part of this study. Viral and bacterial diseases are seen as major factors limiting yield and stability of the crop. These can be addressed through good management, research and breeding.

"This Crawford Fund Award provided me the opportunity to travel to Myanmar and Taiwan to link with researchers on the current Australian Centre for International Agriculture (ACIAR) project CIM 2014/079, 'Establishing the International Mungbean Improvement Network' (IMIN)," said Thomas.

"The objectives and expected outcomes of my PhD research align with the interests of the IMIN and will help to further my career through: new experiences gained from the award, broadening my knowledge base, development of lasting professional connections, and, providing an avenue to pass on my knowledge of bacterial disease isolation and identification in combination with breeding strategies."

An initiative of the IMIN is to provide better access to diverse germplasm to address key abiotic and biotic stressors causing substantial effects on yield and the resilience of the crop. While in Myanmar discussions were held about how to access and make use of genetically diverse germplasm, crossing methods, the national priority key traits for both Myanmar and Australia; and, how to incorporate disease resistance.

Bacterial diseases affecting mungbeans such as halo blight have gone uncharacterised in Myanmar. This is primarily due to the limited available resources being focused on Mungbean Yellow Mosaic Virus (MYMV) which is a devastating disease affecting all Asian growing regions.

"While in Myanmar I provided support to the breeding, pathology and biotechnology teams to help identify bacterial disease and developed protocols to continue ongoing surveillance of symptoms and identification. Identification of MYMV and learning about resistant germplasm will help Australia prepare for any incursions of the disease. Although MYMV has not been found in Australia it is highly transmittable and could arrive through our nearest neighbors in South East Asia. Having firsthand knowledge of the symptoms and knowing about varieties with resistance will help prevent its establishment and reduce its impact in Australia," said Thomas, explaining the importance of his work to the Australian mungbean industry.

Halo blight a bacterial disease caused by Pseudomonas savastanoi pv. phaseolicola causes losses of 30-50%, and in severe cases, when conditions are ideal for symptom development, can lead to total crop failure in Australia and China. There are currently no reports of halo blight in Myanmar and most other mungbean growing regions throughout Asia. In contrast, MYMV is the primary disease of concern affecting mungbeans in these regions. Due the severity of MYMV and its prolific nature other diseases arising from bacterial pathogens are potentially going undetected and/or uncharacterised. A primary aim of this study was to investigate which bacterial pathogens were present on mungbean crops in Myanmar. If suspected bacterial infections were identified, molecular assays would be performed to assess the variation between locations and to confirm if the causal agent is Pseudomonas savastanoi pv. phaseolicola, or some other pathogen.

"I visited three of the primary mungbean growing regions in Myanmar where I collected samples symptomatic of halo blight. The regions visited were Magway, Bagan and Tatkon. In total, 30 strains of bacteria were isolated, representing approximately 10 from each region," said Thomas.

After isolation and production of pure cultures, each isolate was DNA fingerprinted using randomly amplified polymorphic DNA (RAPD) primers. DNA from each strain was extracted and stored in -40°C until a permit has been acquired to import the samples into Australia for further analysis. Sequencing of the 16S rDNA gene will provide accurate identification of the genus and potentially the species of bacteria isolated.

Sharing knowledge and methods about crossing eg. when is the best time to cross and how to pick female and male buds for maximum fertility.

Researchers and farmers in Myanmar benefit from this research through links to Australian institutes and researchers providing new avenues for study opportunities in Australia; by learning to identify, isolate and characterise bacterial isolates; by having DNA sent to Australia to determine species; and developing a foundation of knowledge to continue research into the effects bacterial disease have on mungbeans.

Queensland benefits from this work by the development of networks with researchers and institutes to collaborate on mungbean research; enhanced knowledge of mungbean breeding and genetics which will allow better varieties to be developed faster; potential germplasm exchange such as wild varieties with novel genetics and genotypes; and early detection of diseases like halo blight or other bacterial pathogens if they are present in Myanmar.

"The Crawford-in-Qld Student Award provided me an opportunity to gain experience researching in a very different social, environmental and cultural setting. Spending an extended period of time working on the ground with the researchers and farmers allowed me to gain insight into the breeding, production and management of mungbean farms in Myanmar," he said.

"I would like to thank the Crawford Fund for providing the scholarship to travel to Myanmar where I got the opportunity to broaden and share my knowledge on mungbean pathology and breeding; Sagadevan Mundree from the Centre for Tropical Crops and Biocommodities for providing further funding to extend the trip; Col Douglas from the Department of Agriculture and Fisheries for linking me in with his networks to make the trip possible;

Anthony Young from the University of Queensland for passing on his knowledge of how to identify and isolate bacterial disease; The Australian Mungbean Association for supporting the trip as a recipient of their industry funded PhD scholarship; and, The Department of Agricultural and Research in Yezin, Myanmar for hosting me and taking time out of their busy schedules to accommodate my needs from sample collection to access to laboratories and facilities," he concluded.

Global Tan Spot Disease Resistance in Wheat the Focus of QLD Student

Tamaya Peressini, University of Queensland

In 2018, Tamaya Peressini, from The Queensland Alliance for Agriculture and Food Innovation (QAAFI), a research institute of the University of Queensland (UQ), travelled to CIMMYT in Mexico as part of her Honours thesis research focused on a disease called tan spot in wheat.

Tan spot is caused by the pathogen Pyrenophora triciti-repentis (Ptr), and her project aimed to evaluate the resistance of tan spot in wheat to global races to this pathogen.

"The germplasm I'm studying for my thesis carries what is known as adult plant resistance (or APR) to tan spot, which has demonstrated to be a durable source of resistance in other wheat pathosystems such as powdery mildew," said Tamaya.

Tan spot is prevalent worldwide, and in Australia causes the most yield loss out of the foliar wheat diseases. In Australia, there is only one identified pathogen race that is prevalent called Ptr Race 1. For Ptr Race 1, the susceptibility gene Tsn1 in wheat is the main factor that results in successful infection in Ptr strains that carry Toxin A. However, globally it is a more difficult problem, as there are seven other pathogen races that consist of different combinations of necrotrophic toxins. Hence, developing cultivars that are multi-race resistant to Ptr presents a significant challenge to breeders as multiple resistant genes would be required for resistance to other pathogens.

"At CIMMYT I evaluated the durability of APR I identified in plant material in Australia by inoculating with a local strain of Ptr and also with a pathogen that shares ToxA: Staganospora nodorum."

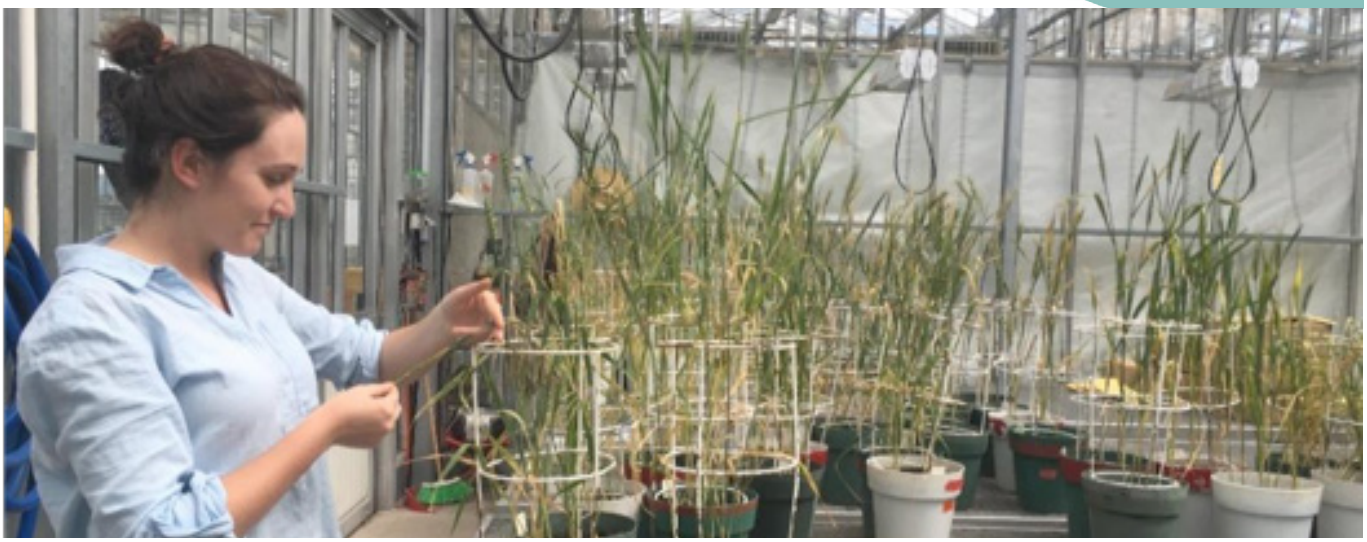
"The benefit of studying this at CIMMYT was that I had access to different strains of the pathogen which carry different virulence factors of disease, I was exposed to international agricultural research, and importantly, I was able to create research collaborations that would allow the APR detected in this population to have the potential to reach developing countries to assist in developing durably resistant wheat cultivars for worldwide deployment," explained Tamaya.

Recent work in Dr Lee Hickey's laboratory in Queensland has identified several landraces from the Vavilov wheat collection that exhibited a novel resistance to tan spot known as adult plant resistance (APR). APR has proven to be a durable and broad-spectrum source of resistance in wheat crops; namely with the Lr34 gene which confers resistance to powdery mildew and leaf stem rust of wheat.

"My research is focussed on evaluating this type of resistance and identifying whether it is resistant to multiple pathogen species and other races of Ptr. This is important to the Queensland region, as the northern wheat belt is significantly affected by tan spot disease. Introducing durable resistance genes to varieties in this region would be an effective pre-breeding strategy because it would help develop crop varieties that would have enhanced resistance to tan spot should more strains reach Australia. Furthermore, it may provide durable resistance to other necrotrophic pathogens of wheat," said Tamaya.

The plant material Tamaya studied in her honours thesis was a recombinant inbred line (RIL) population, with the parental lines being the APR landrace (carries Tsn1) and the susceptible Australian cultivar Banks (also carries Tsn1). To evaluate the durability of resistance in this population to other strains of Ptr, this material along with the parental lines of the population and additional land races from the Vavilov wheat collection were sent to CIMMYT for Tamaya to perform a disease assay.

"At CIMMYT I evaluated the durability of APR identified in plant material in Australia by inoculating with a local strain



of Ptr and also with a pathogen that shares ToxA: Staganospora nodorum. After infection, my plant material was kept in 100 per cent humidity for 24 hours (12 hours light and 12 hours dark) and then transferred back to regular glasshouse conditions. At 10 days post infection I evaluated the resistance in the plant material."

From the evaluation, the APR RIL line demonstrated significant resistance compared to the rest of the Australian plant material against both pathogens. The results are highly promising, as they demonstrate the durability of the APR for both pre-breeding and multi-pathogen resistance breeding. Furthermore, this plant material is now available for experimental purposes at CIMMYT where further trials can validate how durable the resistance is to other necrotrophic pathogens and also be deployed worldwide and be tested against even more strains of Ptr.

"During my visit at CIMMYT I was able to immerse myself in the Spanish language and take part in professional seminars, tours, lab work and field work around the site. A highlight for me was learning to prepare and perform toxin infiltrations for an experiment comparing the virulence of different strains of spot blotch."

"I also formed valuable friendships and research partnerships from every corner of the globe and had valuable exposure to the important research underway at CIMMT and insight to the issues that are affecting maize and wheat growers globally. Of course, there was also the chance to travel on weekends; where I was able to experience the lively Mexican culture and historical sites – another fantastic highlight to the trip!"

"I would like to thank CIMMYT and Dr Pawan Singh for hosting me and giving the opportunity to learn, grow and experience the fantastic research that is performed at CIMMYT and opportunities to experience parts of Mexico. The researchers and lab technicians were all so friendly and accommodating. I would also like to thank my supervisor Dr Lee Hickey for introducing this project collaboration with CIMMYT. Lastly, I would like to thank the Crawford Fund Queensland Committee for funding this visit; not only was I able to immerse myself in world class plant pathology research, I have been given valuable exposure to international agricultural research that will give my research career a boost in the right direction," concluded Tamaya.

SOUTH AUSTRALIA

Improving the Efficiency of Biogas – Power from Poo Research in Nepal

Mathu Indren, University of Adelaide

In November 2018, The Crawford Fund facilitated Mathu Indren's four-week research trip to Nepal, where he worked with two private companies, WindPower Nepal and Gandaki Urja at their joint venture biogas plant. The plant is located 20 kilometres from Pokhara in central Nepal, and processes 45 tonnes of cattle, swine and poultry manure a day.

Biogas is a form of renewable energy produced from the decomposition of organic material by microorganisms in an environment that is anaerobic (or without air). Engineered systems for biogas production are termed anaerobic digesters or bio-digesters.

"My PhD project is focussed on improving the efficiency of biogas production from manure by adding in biochar into the anaerobic digesters," said Mathu.

"My goal for this research trip was to develop an understanding on the feasibility of using biochar in both domestic and large-scale digesters in Nepal and to understand the operational considerations involved in running a biogas plant."

The use of manure for biogas production is not a new idea for Nepal as there are approximately 30,000 domestic scale digesters (2-8m3) in the country, however, the idea of a centralised, large-scale plant is a new idea for Nepal, with the first constructed in 2017. The plant in Pokhara is the country's latest and the largest at 2700 m3.

At this scale, the purification of biogas, which contains methane and carbon dioxide into a gas that contains 97 per cent methane, termed 'bio-methane' becomes economically feasible in Nepal.

"Bio-methane production is gaining popularity in Europe and has been used in India. Despite Australia's significant livestock population and several biogas plants we do not have a single bio-methane plant," said Mathu.

"This research trip exposed me to some challenges and opportunities that I would not have been able to imagine. Within my first week in Nepal my colleagues and I travelled to various farms as they negotiated prices to purchase manure from their livestock."

"Despite the manure being produced by their livestock being a real nuisance for farmers to manage, the farmers were never willing to give it away free."

"In addition, many of these farms did not have easy access for trucks, making manure collection troublesome, and the cattle farms in the area were small and housed just 10-15 cows with the largest containing 200 cows, so a dedicated feedstock manager was needed to manage collection of manure from all of the farms to ensure a consistent supply," said Mathu.

"I also developed an understanding of environmental benefits due to improved manure management that centralised anaerobic digesters can offer," said Mathu.

Centralised anaerobic digesters offer farmers another management option beyond selling it as a fertiliser and using it themselves.

Farmers are able to sell their livestock manure as a fertiliser for two-three months of the year. At other times, it is spread onto land or stockpiled. As the average land holding for farmers is small (around 0.7 hectares) there is limited space for manure to be applied. When manure is stockpiled, odour nuisance becomes an issue, with several farms forced to move due to odour complaints from neighbours.

"We also visited several farms which had domestic digesters installed. Many of these digesters were not being used and my colleagues stated how farmers did not always operate digesters in winter and some are eventually abandoned due to low gas yields. This highlighted the need for education and support that must be given to biogas plant users in order for them to have a consistent supply of biogas," said Mathu.

"I was able to share my research findings on how biochar can be used to benefit anaerobic digesters, which was met with great enthusiasm. As a result, we were able to develop a research plan to test the increases in biogas yield when biochar created from an invasive species Eupatorium adenophorum sprengel (known in Nepal as "banmara") is added into an anaerobic digester."

"Overall, this experience was incredibly valuable and greatly broadened my research experience. The insights gained from this experience will help to design studies that are relevant to biogas producers both in developing countries and in Australia," concluded Mathu.

TASMANIA

Forage Assessment for Intensification of Beef Cattle Production in Vietnam

Melinda Sward, University of Tasmania

Melinda Sward is undertaking an Associate Degree in Agribusiness at the University of Tasmania and she travelled to Vietnam for two weeks to undertake work in forage assessment for "Intensification of beef cattle production in upland cropping systems in Northwest Vietnam".

"The aim of the forage project, which sits within the larger livestock intensification project, was to investigate the efficacy of growing temperate oats in the sub-tropical environment for livestock feed utilising residual moisture from harvested rice cropping areas," said Melinda.

"I visited several research institutions involved in forage and livestock research, including the Thai Nguyen University of Agriculture and Forestry (TUAF), where they showed me the university and their offsite farms that had elephant grass growing to feed the cattle. TUAF also includes a buffalo and horse research facility.

"I also visited the National Institute of Animal Science (NIAS) in Hanoi and met with all the people involved in the project and toured their research and study facilities. After NIAS, we met with researchers at the Northern Mountainous Agriculture and Forestry Science Institute (NOMAFSI) in Phu Tho, who presented their research, and their input in the project and took me on a tour showing me farms of different grass varieties, buffalo, tea trees, mangos, peanut farms, bananas and many more different fruit types.

"My initial proposal was to work with the project team to investigate temperate legumes, but unfortunately the seed did not arrive in time to run the trials in this growing period, so I spent my time with some architecture students and researchers undertaking an oat trial."

The group of architecture students from Tasmania were also working on the ACIAR project, but in the area of cattle shelters. As a result, Melinda briefly visited the Hanoi Architectural University and learnt about what they are doing, including the project building cattle shelters for farmers. They use the word Agri-tecture as the joining of two disciplines: Agriculture and Architecture.

The group then travelled to Tuan Giao in Dien Bien province and visited several different farms, saw the trial sites and interviewed farmers.

Many cattle farmers follow their cattle around all day to allow them to have access to sufficient feed. Hopefully, the results of the forage trials can help farmers avoid this inefficient use of their time by providing valuable and easily accessible feed for their cattle.

"As part of my research I spoke directly to the farmers to get feedback on their farm and their productivity. Most farmers said they wanted to improve the future line of cattle; they wanted to improve the growth and quality of the grass to feed their cattle; and, they wanted to bring in new advanced technologies to improve the farms working efficiency.

Most farmers with cattle also had buffalo, pigs and chickens and grew annual cash crops such as maize. The dominant grass variety used for feeding the cattle was elephant grass, although the planting was not regular or enough for year-long supply.

Treatments for the oat trial included water/irrigation and planting date. Yield was then to be assessed from different harvesting times and frequency. The trials had only just been established so we only undertook very preliminary assessment of germination.

"I really enjoyed learning about how forages fitted within the larger beef project and how much Vietnamese agriculture is growing. I also learnt that whilst Vietnam is different to Australia in terms of culture, food, the cities, their homes and farms, farmers all over are still looking for solutions to feed their livestock when water is limited and always keen to improve how they farm."

"I would like to start with thanking the Crawford Fund for the generous scholarship that allowed me to travel to Vietnam to learn about the agricultural projects that are being conducted," she concluded.

VICTORIA

Exploring Farmer Livelihoods and Herd Health in Rural Myanmar

Ziyang Loh, University of Melbourne

In September, Ziyang Loh, a veterinary student from the University of Melbourne travelled with a group to Myanmar as part of his research supported by the Crawford Fund Student Award. Here they were joined by a team from a local University of Veterinary Science (UVS) team in Yezin who would later accompany them on all their village visits.

Myanmar's Central Dry Zone (CDZ) has limited rainfall and is particularly harsh for agricultural producers, yet a large proportion of the country's agricultural population (and their animals) reside in this area. The goal of the work in which Ziyang was involved was to run pilot surveys and surveillance to pave the way for future research associated with the ACIAR project on improving livelihoods of small-scale livestock producers in the region through research on animal production and health. This involved interviewing livestock farmers to gather information on the socioeconomics of their household and assessing the overall health of their herd through a visual veterinary assessment and collecting blood samples for further evaluation.

"Whilst this trip provided plenty of opportunities for data collection, it also allowed us to experience first-hand how different production systems operate in this country. The Myanmar hospitality did not go unnoticed, and we were very grateful for the refreshments and responses the villagers provided us during our survey work", said Ziyang.

Prior to their field work, Dr Angus Campbell and Dr Jenny Hanks, both from the University of Melbourne, ran a brief workshop on how to interview farmers and how to process blood samples. Together with the UVS team, the participants practiced producing blood smears, using a refractometer and learning about centrifuges.

"If there were any similarities between Myanmar farms and Australian ones, it would be the bumpy, dusty, pot hole-filled roads that lead to them. We were transported in two alarmingly low-riding vans. Despite this height limitation, our Myanmar drivers were unphased by the road conditions and navigated the tightest corners and deepest ruts with ease."

"As with all the future villages we visited, we first spoke to the village head about why we were there and what we hoped to achieve. Once formalities had been exchanged, we were guided to various farming households by the local animal health workers. From here, the UVS team would interview the farmers in Myanmar language, using

our printed survey sheets as a guide. They would record their answers in English which allowed us to probe further if required."

Farmers were interviewed about the ownership and management of goats and sheep to allow researchers to gain an idea of the overall size and make-up of an average village flock; who was involved in the husbandry and important decision-making with regards to the flock including who decided when to buy and sell the animals and how the profits were used.

The farmers were also asked about whether they had any issues with certain tasks such as the price they received for livestock and labour availability and any diseases that they thought were an issue on their farm.

Once the survey answers had been recorded, the villagers were thanked, and their permission was sought by the researchers to observe their flock and to take two blood samples. Any abnormal clinical signs were recorded.

The blood samples taken at the villages were processed back at the hotel on the same day to ensure cell preservation and accurate results. To ensure the blood smears we prepared would survive the trip back to Australia, we dipped them in 70% methanol to 'fix' them onto the slides.

"This trip to Myanmar provided a unique opportunity to work alongside the current and future veterinarians of Myanmar. Together, we consolidated critical thinking and practical skills required to perform veterinary research to a high level," said Ziyang.

"The structure of farming households, the role of each individual in a family and economics of farming, are all important aspects that gradually help build an overall picture of Myanmar's agricultural community. As we gather more information, we can better understand how such enterprises function, and how we can build and improve upon these areas....and improve the livelihoods of Myanmar's farmers for the future."

"I would like to thank the following groups and individuals for the hard work and support they provided during the trip: Dr Angus Campbell and Dr Jenny Hanks (University of Melbourne) for organising a once in a lifetime opportunity and trip; The Crawford Fund for providing the scholarship funding required to travel to Myanmar and conduct veterinary research; the University of Veterinary Science (Yezin) for their assistance in translating interviews and sample processing; the Faculty of Veterinary and Agricultural Sciences (University of Melbourne); ACIAR; and my fellow DVM classmates who accompanied me on this trip. Many interesting discussions and experiences were shared between the four of us," he concluded.

Agricultural Innovations for Communities in Timor-Leste

Kimberly Pellosis, University of Melbourne

When I started studying agriculture and environmental science at university, never in a million years would I have thought that it would provide me with the opportunity to meet the most amazing and inspiring people, while travelling to the most distant and surreal destinations, working on the most interesting and fulfilling research projects. I've been incredulously fortunate to be able to go to Timor-Leste and work with the Australian Centre for International Agricultural Research (ACIAR) and Agricultural Innovations for Communities (AI-Com) group to support intensified and sustainable farming systems.

Agricultural research and development assistance projects in overseas countries were something that I hoped to gain experience in and contribute towards, coming from a developing country myself. Giving back to the global community and applying what I've learned at university to initiatives that would make a world of difference to smallholder farmers was something that I was drawn towards, as I felt quite obligated, and privileged to grow up and obtain an education in a country as flourishing and prosperous as Australia.

Timor-Leste depends on its agricultural sector for financial and economic security. The nation's Ministry of Agriculture, Forestry & Fisheries estimates that 80 per cent of the population consists of local, smallholder farmers that depend on annual crop yields for survival, and according to ACIAR data, two-thirds of its 1.17 million population live on less than US$2 a day.

The ACIAR Agricultural Innovations for Communities for intensified and sustainable farming systems in Timor-Leste (AI-Com) project was the perfect match to my background and interests. AI-Com is a collaborative model research organisation determined to improve agricultural productivity and profitability to communities in Timor-Leste – reaching up to approximately 5000 farming families, introducing economic resilience to the local farming economy.

After my arrival, Robert Williams, Technical Director for AI-Com, fellow AI-Com researcher Luis de Almeida, and I embarked on the famous 'South Coast Tour', which involved visiting experimental research plots and farming enterprises in Maubisse, Same, Suai, Betano, Natarbora and Viqueque.

Throughout the tour, we consulted with various growers, and learned about the ways in which adaptive research could improve agricultural productivity within the local area.

Examples of the research we visited and advised on include:

- In mountainous Maubisse, Same and Suai, various varieties of mung beans were being trialled to assess which variety could thrive in the south coast of Timor-Leste, where planting time could potentially support the growth and yield of the crop.
- At the Betano Research Station, there were multiple agronomic trials, from assessing variations in timing for intercropping maize and red beans, and evaluating pigeon pea and cowpea varieties, to randomised split plots for different varieties of red bean.

- At the Natarbora Agricultural Technical School, we caught up with students as they were watering their plots, consisting of intercropping trials for maize and beans to investigate and compare cropping yields.
- At a Sandalwood Plantation, teachers from the Natarbora Agricultural High School were testing the ideal technique and duration for seed soaking, and whether different input factors can significantly affect the growth rate of the plant.
- We met up students from the University of Timor-Leste, as they collected social research data through in-depth one-on-one interviews with families aimed at providing a great 'snapshot' of families around the neighbouring areas of Natarbora.
- In Viqueque, we visited rice farms that introduced biochar and broadcasting into their cropping rotation. Given that the soil in Timor-Leste is generally quite deficient, biochar can be an economically efficient and sustainable input opportunity for farmers to increase their agricultural productivity and yield.
- Back in the capital, Dili, we went through an Agricultural Production Systems Simulator (APSIM) training course and tried to model and predict yields for various crops based on existing weather data, and by modifying various rates and factors such as soil type, sowing rate, fertiliser rate and surface organic matter.

As Asia's newest nation, Timor-Leste is a country determined to rebuild itself from the ground up. Timor-Leste presents a wonderful opportunity for students, researchers and scientists to apply theory into practice, and be sure that efforts would have immediate positive impacts to growers and their standard of living.

I've fallen in love with the country, and the positivity, warmness and kindness of its people. As I embark on my plane and leave this enchanted island, and on to my next journey, I leave with a heightened sense of appreciation and awe towards agriculture for development, and Australia's engagement in international agricultural research and development. I thank the Crawford Fund for making all this possible.

WESTERN AUSTRALIA

"It won't be the last time that I come to this country"

Christian Berger, University of Western Australia

Most recently, we received a report from Christian Berger, a Geographical Science (Honours) Student at the University of Western Australia. Christian's award has him writing to us from Maliana, Timor-Leste where he has been conducting interviews with local young farmers. When asked of his experience so far, Christian reported:

> My experience here in Timor-Leste has exceeded my expectations by a long shot. Within a few days, I was fortunate enough to find a research assistant, named Cristina, who has been enthusiastic from day one. Not only does she work hard, but she also works patiently with me, so that I can reach my research goal being in this country only six weeks. Of course, not everything went according to plan, however, as we managed to deal with minor hiccups, we worked better together and started to become a great team. Not only did she help me a lot with my research, I am very happy to have helped her in many other ways too, such as teaching English. Living in the rural area of Timor-Leste really puts into perspective what humans really need. To put food on the table for our families and to be loved by those close to us. In a way, I felt like I was sent back in time to my own childhood, where a lot farm work was done manually. I feel comfortable talking to them about their opportunities and challenges in farming. Working in the field with the young farmers trying to reveal some of their major challenges will contribute valuable information for the host AI-Com. Although I am not fluent in the local language Tetun, walking along the streets of Maliana and talking to many locals about their daily struggles has broadened my horizon. That is what I want to build on in my future career. I have only two more interviews to conduct with local youth that have moved from Maliana to Dili. I look forward to going back home to share all these experiences with my partner, however, I will leave this country a little melancholy – it won't be the last time that I come to this country.

Christian's work is connected with the collaborative research program funded by ACIAR called "AI-Com: Agricultural Innovations for Communities for intensified and sustainable farming systems in Timor-Leste" which aims to improve agricultural productivity and profitability for around 5000 farming families. You can follow their work at their active facebook page www.facebook.com/AICOMTL and on their web page www.ai-com.tl.

Rob Williams, the Technical Director of AI-Com and well known to many from his work with ACIAR's Seeds of Life project in Timor Leste, tells us "Christian has been great to have with us at AI-Com, and he has been very diligent in learning Tetun and understanding what is happening around him. Christian is involved in the social research aspect of our research, which is one of the four components. We not only want to spread new and innovative practices, but to understand why farming families adopt some and not others," said Rob.To help with this social research, Christian has been interviewing farmers and below he has shared with us the stories from two young farmers that face numerous issues on their farms. We wish Christian and AI-Com much success!

FARMER #1 – A male farmer (30) from Corluli, which is about a half hour motorbike ride away from Maliana, faces many problems especially during the busy wet season. Quite often money isn't available to buy fertiliser, seeds and to borrow a tractor to farm the rice fields. In the dry season, his man-made irrigation channels don't carry enough water for him and his community, therefore growing his own vegetables, such as cabbage, mustard, water spinach, tomatoes and chillies, he has to suffice his family's needs. In the future he would like to continue his education at university and to one day come back to his community and help in developing it but without limited additional income, his family cannot afford to send him back to university. In his free time, he enjoys singing and playing football with his friends on nearby land. One day, he hopes the government will come and create a football field for the community to play on. Despite his hardship as a young farmer in such a remote area of Timor-Leste, he kept on smiling and repeated what so many other young farmers said: "I will stay here, because I have my family here and I can plant my own food – I am happy here".

FARMER #2 – A female farmer (23) from Samelaun struggles mostly with a lack of water during the dry season. Her rice field and vegetable garden, just across the main road through her community of Samelaun, are technically connected to the main irrigation in Maliana. However, as many other farmers take out water for their own use along the way, this young farmer struggles to get enough water in the dry season. The use of technology lightens her workload during the busy wet season, however, to pay for tractor and labourers, she and her newly-wed husband need to work hard during the dry season to earn additional income. He works as a security guard in Maliana town, while she makes cassava chips and sells them at a friends' kiosk. All over Maliana, parents would like their children to go to university to further educate themselves. Similar to most families, this female farmer's parents feel the same, however, she doesn't want to go back to study because her parents are getting older and she wants to be there for them. Family is very important and so is land to grow her own food on. She would never consider moving to another district to leave all of her life behind.

ABOUT OUR STUDENT AWARDS

The Crawford Fund employs a number of strategies as part of our efforts to build the next generation of Australian researchers with an interest in agricultural research and development, including our Student Awards, conference scholar program, volunteering for projects overseas, and through our work with Researchers in Agriculture for International Development (RAID).

These strategies are part of our overall campaign for greater recognition of the impact and benefit of international agricultural research and development to Australia and to developing countries.

Our Student Awards, launched in 2017, and supported by our State and Territory Committees, allow university students to visit developing countries and gain valuable experience and expertise overseas 'in the field'.

Find out more at: www.crawfordfund.org/awards/crawford-fund-student-awards/