Pacific Community
Communauté du Pacifique

Proceedings of the Pacific Regional Research Symposium 22–23 May 2025

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Transforming agriculture and forestry in the Pacific through science, technology, and partnerships

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Contents

Executive summary

The inaugural Pacific Regional Research Symposium took place at the Tanoa Dateline Hotel in the Kingdom of Tonga on 22–23 May 2025. The symposium brought together 180 researchers, technical experts, government representatives and development partners to share their recent research and innovations aimed at addressing challenges in the agriculture and forestry sectors in the Pacific Island countries and territories (PICTs).

The initiative for the symposium originated from the testing of the Regional Research Agenda (RRA) framework, which highlighted a lack of knowledge-sharing platforms within PICTs for researchers to share their work. To some degree, the lack of knowledge-sharing opportunities has resulted in the duplication of research efforts. Therefore, the peer reviewers and the Pacific Community took a proactive step to spearhead the organisation of the Pacific Regional Research Symposium. The event was held as a pre-side event of the Pacific Week of Agriculture and Forestry (PWAF) in Tonga. It was acknowledged and supported by the Pacific Heads of Agriculture and Forestry Services (PHOAFS) as a platform to encourage researchers to present and share their findings. At the symposium, the first-ever *Journal of Agriculture and Forestry in the Pacific (JAFPac)* was launched.

This proceedings document, compiles the abstracts presented during the oral and poster sessions. Some of the papers are currently under review for the second issue of JAFPac. The intention of the proceedings is to provide valuable insights into the research conducted in the region. The symposium will be held every two years, with the next one planned for 2027 prior to the PWAF, which is set to take place in Solomon Islands.

The symposium was made a reality with technical and administrative support from the Tongan Ministry of Agriculture, Forests and Food, and the Tonga National University. Funding support was provided by the Australian Centre for International Agricultural Research, and the New Zealand Ministry of Foreign Affairs and Trade, through its Funding with Intent Programme, as well as the International Congress for Biological Invasions 2023.

Final programme

Day 1: 22 May 2025		
7:30 a.m. – 8:30 a.m.	**Registration Symposium Committee**	
8:30 a.m. – 9:00 a.m.	**Official opening - MC: Kalati Malo Hafokati**	
	Prayer - Rev Viliami Fangupo Vaka	
	Remarks by Elsie Fukofuka Regional Director, Polynesia Regional Office	
	Official opening by the Honourable Dr Siosiua Moala Halavātau, Minister for Agriculture, Food and Forests, Kingdom of Tonga	
9:00 a.m. – 9:30 a.m.	**Morning tea**	
Session 1: Sustainable agriculture systems Chair: Dr Ingrid Van Putten – Research Director, Australian Centre for International Agricultural Research		
9:30 a.m. – 9:40 a.m.	**Plenary** Challenges and opportunities for soil resources in the Pacific	Honourable Dr Siosiua Moala Halavātau Minister for Agriculture, Food and Forests, Tonga
9:40 a.m. – 9:50 a.m.	The effect of nutrient inputs on tree nutrient status and yields of cacao (*Theobroma cacao*) in Solomon Islands.	Simon Iro Sefa Massey University
9:50 a.m. – 10:00 a.m.	Evaluation of Vanuatu peanut varieties for pod yield and aflatoxin	Shital Marai Vanuatu Agricultural Research and Technical Centre (VARTC)
10:00 a.m. – 10:10 a.m.	Assessing soil health indicators and nutrient status between two contrasting agro-ecological zones in Samoa	Ann Julie Johnson University of the South Pacific
10:10 a.m. – 10:20 a.m.	Effects of sustainable intensification practices on soil moisture levels of root cropping systems in Samoa and Tonga	Faatoialemanu Areta University of the South Pacific
10:20 a.m. – 10:30 a.m.	Increases in extreme dry season rainfall events could be having a negative impact on Vanilla flower induction in Vava'u, Tonga	Dr Bruce Smallfield The New Zealand Institute for Plant and Food Research Limited
10:30 a.m. – 10:50 a.m.	Question and Answer Session	Session Chair Dr Ingrid Van Putten Research Director, Australian Centre for International Agricultural Research
10:50 a.m. – 11:00 a.m.	Ice breaker	Symposium Committee
Session 1: Sustainable agriculture systems Chair: Dr Wee Tek Tay, Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation		
11:00 a.m. – 11:10 a.m.	**Plenary** The eradication plan of Citrus Tristeza Virus in two islands of French Polynesia	Dr Maurice Wong Direction de l'agriculture, RIV French Polynesia
11:10 a.m. – 11:20 a.m.	Seasonal abundance and host range of thrips (Insecta: Thysanoptera) in eggplant (*Solanum melongena* L.) agroecosystems of Western Viti Levu, Fiji	Aradhana Deesh University of the South Pacific and Crop Research Division, Ministry of Agriculture, Suva, Fiji
11:20 a.m. – 11:30 a.m.	Impacts of citrus black fly on lime production in Republic of the Marshall Islands: The case of Laura Village.	Watak Lanwe College of the Marshall Islands, Land Grant Cooperative Research & Extension
11:30 a.m. – 11:40 a.m.	Protecting the Pacific tree of life from the invasive coconut rhinoceros beetle: Current status and future directions	Dr Sulav Paudel AgResearch New Zealand

11:40 a.m. – 11:50 a.m.	Status of sugarcane smut (*Sporisorium scitaminea*) in Papua New Guinea after eight years	Marilyn Apa National Agriculture Quarantine & Inspection Authority - Papua New Guinea
11:50 a.m. – 12:00 a.m.	Biological control in agriculture in French Polynesia	Dr Julie Grandgirard Direction de l'agriculture de Polynésie française French Polynesia
12:00 a.m. – 12:20 a.m.	Question and answer session	Session Chair Dr Wee Tek Tay Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation
12:00 a.m. – 1:30 p.m.	**Lunch**	
Session 1: Sustainable agriculture systems Chair: Professor Md Abdul Kader, Discipline Coordinator, Agriculture and Food Technology Discipline, University of the South Pacific		
1:30 p.m. – 1:40 p.m.	**Plenary** Confirming the presence of symbiotic nitrogen-fixing bacteria (*Rhizobia* sp.) in the soil of taro- based (*Colocasia esculenta*) cropping system in Samoa	Dr Leslie Ubaub University of the South Pacific
1:40 p.m. – 1:50 p.m.	Effect of temperature and humidity on broad mite dynamics, feeding damage, and arthropods associated with capsicum under protected structures in Fiji.	Leikitah Katah Naituku University of the South Pacific
1:50 p.m. – 2:00 p.m.	Knowledge gaps in forest genetic resources in Pacific Island countries and territories – A systemic review	Iliesa Koroi University of the South Pacific
2:00 p.m. – 2:10 p.m.	Oviposition patterns and egg mass composition of large cabbage moth, *Crocidolomia pavonana* on head cabbage foliage in Samoa.	Sateki Fangupo University of the South Pacific
2:10 p.m. – 2:20 p.m.	Survey and molecular detection of phytoplasma and its spread and distribution in the Markham District of Morobe Province, in Papua New Guinea.	Gou Rauka National Agriculture Research Institute
2:20 p.m. – 2:30 p.m.	The richness of weeds in the seed-bank post-production: an insight into the soil planted with taro as affected by different leguminous mulching materials and weed management approaches in Samoa	Kerinina Leaupepetele University of the South Pacific
2:30 p.m. – 2:50 p.m.	Question and answer session	Session Chair Professor Md Abdul Kader, Discipline Coordinator, Agriculture and Food Technology Discipline, University of the South Pacific
2:50 p.m. – 3:10 p.m.	**Afternoon tea**	
Session 2: Enablers of research Chair: Professor Heather Worth, Director, Te Puna Vai Marama, Cook Islands Centre for Research, University of the South Pacific, Cook Islands Campus and Adjunct Professor, School of Population Health, University of New South Wales, Sydney		
3:10 p.m. – 3:20 p.m.	Plenary Higher education meets food systems thinking in the Pacific: A case study of agroecological connections between community and academia	Kyle Stice University of Hawaii
3:20 p.m. - 3:30 p.m.	Elevating and recognising knowledge of indigenous peoples to improve forest biosecurity.	Alby Marsh Better Border Biosecurity and Plant and Food Research, New Zealand
3:30 p.m. – 3:40 p.m.	Enhancing TEK in agriculture practices: Lessons from Baelelea, Solomon Islands	James Faiau Land Resources Division, SPC
3:40 p.m. – 3:50 p.m.	Exploring perspectives on land tenure in Tonga: A case study of Tongatapu	Holomesi Finau University of the South Pacific

3:50 p.m. – 4:00 p.m.	Tapping into the potential of farmers living with disabilities – An experience from Samoa	Lilomaiava Florence Saaga Women in Business Development Inc.
4:00 p.m. – 4:10 p.m.	**Ice breaker**	**Symposium Committee**
4:10 p.m. – 4:20 p.m.	Educational institutional approach through partnership for sustainable agricultural development: A case of Fiji National University	Dr William Kerua Fiji National University
4:20 p.m. – 4:40 p.m.	Enhancing research in the Pacific through the Pacific Climate Change Research Roadmap 2025	Yvette Kerslake Pacific Regional Environment Programme
4:40 p.m. – 4:50 p.m.	Connecting-the-Va (space/gap): A framework to build relationships for effective partnerships and multi-disciplinary agricultural-climate-livelihood research in Pacific Island countries.	Lau Dr Viliamu Iese School of Agriculture, Food and Ecosystem Sciences (SAFES), Faculty of Science, University of Melbourne
4:50 p.m. – 5:00 p.m.	The changing role of women in the agriculture sector and their contribution to climate change mitigation and adaptation - A case study of Sigatoka and Ba, Fiji	Radhisha Nath Fiji National University
5:00 p.m. – 5:20 p.m.	Question and answer session	Session Chair Professor Heather Worth Director, Te Puna Vai Marama, Cook Islands Centre for Research, University of the South Pacific, Cook Islands Campus and Adjunct Professor, School of Population Health, University of New South Wales, Sydney
5:20 p.m. – 6:30 p.m.	**Poster session 2: *Talanoa & kava* – Conversations by the posters**	
Day 2: 23 May 2025		
7:30 a.m. – 8:30 a.m.	**Registration**	**Symposium Committee**
8:30 a.m. – 8:40 a.m.	**Prayer**	**Symposium Committee**
Session 3: Climate change Chair: Ofa Kaisamy, Manager, Pacific Climate Change Center, Pacific Regional Environment Programme		
8:40 a.m. – 8:50 a.m.	**Plenary** Testing and adapting a Pacific collaborative regional research agenda: A case study examining Fiji Island farmers' challenges in growing sandalwood and other crops under changing climatic conditions.	Alivereti Naikatini Director, Research Ministry of Forestry, Fiji
8:50 a.m. – 9:10 a.m.	Analysis of the key factors influencing farmers' crop selection in Rarotonga, Cook Islands	Lauren Turner Te Puna Vai Mārama, The Cook Islands Centre for Research
9:10 a.m. – 9:20 a.m.	Nauruan farmers' perceptions government support for resources and guidance	Brenoki Limen Department of Environmental Management & Agriculture
9:20 a.m. – 9:30 a.m.	Climate challenges in New Caledonia, tackling salinity and its effects on the Pacific's principal staple crop, taro (*Colocasia esculenta* (L.) Schott)	Dr Nadia Robert Institut Agronomique néo- Calédonien
9:30 a.m. – 9:40 a.m.	Factors influencing farmers crop production decisions under changing climatic conditions: A case study from the Eastern Highlands Province of Papua New Guinea	Rose Sabub Papua New Guinea National Agriculture Research Institute
9:40 a.m. – 9:50 a.m.	Economic factors in crop selection and farming methods in response to climate change in Tonga	Maurie Mafileo Ministry of Agriculture Food and Forests
9:50 a.m. – 10:00 a.m.	Analysis of climate adaptation methods adopted by farmers in Rarotonga, Cook Islands	Selane Tairea *Te Puna Vai Mārama,* The Cook Islands Centre for Research

10:00 a.m. – 10:10 a.m.	Investigating crop responses to slightly saline irrigation: A research collaboration on desalination and agriculture	Vunivesi Minoneti Director Research Ministry of Agriculture, Food and Forests, Tonga
10:10 – 10:30 a.m.	Question and answer session	Session Chair Ofa Kaisamy Manager Pacific Climate Change Center, Pacific Regional Environment Programme
10:30 a.m. – 10:50 a.m.	**Morning tea**	
Session 4: Food security and nutrition Chair: Dr David Teulon, Principal Scientist, Invasive Species Asia Pacific, Plant and Food Research and Adjunct Professor, Lincoln University		
10:50 a.m. – 11:00 a.m.	Plenary Tonga circular economic systems	Dr Viliami T. Manu Chief Executive Officer Minister for Agriculture, Food and Forests, Tonga
11:00 a.m. – 11:10 a.m.	A farm planning approach to increase profitability and productivity of smallholder cattle farmers in Vanuatu	Dr Simon P Quigley Vanuatu Agricultural Research and Technical Centre
11:10 a.m. – 11:20 a.m.	Agroforestry for strengthening rural livelihoods in Fiji	Lily Qaranivalu-Draunitivi Fiji National University
11:20 a.m. – 11:30 a.m.	Development of mass propagation system for elite varieties of kava (*Piper methysticum* G. Forster)	Abhineshwar Prasad University of the South Pacific
11:30 a.m. – 11:40 a.m.	Cooperative research and extension - Land Grant (College of the Marshall Islands)	Tebeio Tamton Cooperative Research and Extension - Land Grant (College of the Marshall Islands)
11:40 a.m. – 11:50 a.m.	A Journey developing a combination pressure washing and hot water treatment for exporting taro	Dr Allan Woolf Plant and Food Research New Zealand
11:50 a.m. – 12:00 a.m.	Understanding consumers' perceptions and preferences for organic produce in Tonga	Lavenia Mafi Land Resources Division SPC
12:00 a.m. – 12:30 a.m.	Question and answer session	Session Chair Dr David Teulon Principal Scientist, Invasive Species Asia Pacific, Plant and Food Research and Adjunct Professor, Lincoln University
12:30 a.m. – 1:30 p.m.	**Lunch**	
Session 4: Food security and nutrition Chair: Dr Steven Crimp, Research Director, Australian Centre for International Agriculture Research		
1:30 p.m. – 1:40 p.m.	Plenary The diversity of taro – a key indicator of climate resilient food in the Pacific	Caroline Mitchell Landcare Research New Zealand
1:40 p.m. – 1:50 p.m.	Assessment of seven Fijian taro (*Colocasia esculenta* (L.) Schott) varieties for drought tolerance	Jone Foraete Land Resources Division, Pacific Community
1:50 p.m. – 2:00 p.m.	Building social resilience and food security through sustainable agriculture intensification in Samoa and Tonga	Louise Marie Malaki University of the South Pacific
2:00 p.m. – 2:10 p.m.	Investigating local consumer attitudes, habits, and preferences for sheep meat in Samoa	Tusiata Lemuelu Ministry of Agriculture and Fisheries, Samoa
2:10 p.m. – 2:20 p.m.	Characterisation and modification of pectin from Samoan citrus (Tahitian lime and local mandarin) for potential value-added and health promotion applications	Alesana Malo University of the South Pacific
2:20 p.m. – 2:30 p.m.	**Ice breaker**	**Symposium committee**

2:30 p.m. – 2:40 p.m.	Dilution of commercial feed with cassava (*Manihot esculenta*) root meal in combination with moringa (*Moringa oleifera*) and mulberry (*Morus alba*) leaves for crossbred chickens	Faalepeti Pasefika-Seuao University of the South Pacific
2:40 p.m. – 2:50 p.m.	Molecular and Morphological analysis of elite cocoa trees (*Theobroma cacao* L.) on Makira Island, Solomon Islands	Elison Toramo Solomon Islands National University
2:50 p.m. – 3:00 p.m.	In vitro cultivation of Pacific *bele* (*Abelmoschus manihot*)	Arshni Shandil Land Resources Division, SPC
3:00 p.m. – 3:10 p.m.	Peanut seed treatments (PST) for organic peanut production systems in Vanuatu	Shital Marai Vanuatu Agricultural Research and Technical Centre
3:10 p.m. – 3:30 p.m.	Question and answer session	Chair Dr Steven Crimp Research Director, Australian Centre for International Agricultural Research
3:30 p.m. – 5:30 p.m.	**Afternoon tea** **Poster Session 2: Talanoa & Kava – Conversations by the posters**	

Dinner hosted by the Alumni of the ACIAR Scholarship Programmes **MC: Representative from the Ministry of Agriculture, Food and Forests, Tonga**	
7:00 p.m.	**Guests seated**
7:15 p.m.	**Remarks by Karen Mapusua Director, Land Resources Division, Pacific Community**
7:30 p.m.	**Remarks by His Excellency Brek Bately, Australian High Commissioner to the Kingdom of Tonga**
7:45 p.m.	**Official closing by Dr Giulio Masasso Tu'ikolongahau Paunga, Vice Chancellor, Tonga National University - 'Univesiti Fakafonua 'a Tonga Nuku'alofa, Kingdom of Tonga**
8:00 p.m.	**Launch of the Journal of Agriculture and Forestry in the Pacific and awarding of prizes for best poster and oral presentations by the Honourable Dr Siosiua Moala Halavātau, Minister for Agriculture, Food and Forests, Kingdom of Tonga**
8:30 p.m.	**Dinner and karaoke**
8:40 p.m.	**Experience as an ACIAR Scholar** **Salote Nasalo, ACIAR Alumni Representative**
10:00 p.m.	**Dinner ends**

Session 1 Part 1: Sustainable agriculture systems

Chair: Dr Ingrid Van Putten – Research Director, Australian Centre for International Agricultural Research

Challenges and opportunities for soil resources in the Pacific

Siosiua M. Halavatau[1*]

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Soil is vital for agriculture and forestry in the Pacific Small Island Development States (PSIDS). Soil resources are under pressure, however, due to a growing regional population, which will depend increasingly on soils that are now being degraded by inappropriate management practices. The threats to sustainable soil management are: soil erosion caused by water and wind, loss of soil organic carbon, soil nutrient imbalances, soil salinisation (sodicity), soil contamination, acidification, loss of soil biodiversity, soil sealing, soil compaction and waterlogging. The development of solutions to these problems must involve rural communities, using participatory approaches.

Important work has been done in the region to address soil management challenges, including collaborative efforts by ; (i) the Australian Centre for International Agricultural Research (ACIAR), the University of the South Pacific and some countries of the region to improve soil organic carbon using *Mucuna pruriens*, targeted compost and agroforestry practices; (ii) by ACIAR, Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and some countries on nutrient- and water-use efficiency; (iii) by the EU's Development of Sustainable Agriculture Program (DSAP) on soil erosion control; (iv) by Koronivia Joint Work on Agriculture addressing climate-smart agriculture; and (v) by ACIAR, CSIRO, Landcare New Zealand and the Pacific Community's Land Resources Division on a soil information portal.

Other opportunities in the region offer means to improve soil resources for stronger environmental and food security. Soil resources make direct and indirect contributions to several of the UN Sustainable Development Goals (SDGs). There is also an opportunity to develop sustainable soil management guidelines for the region.

The effect of pruning and nutrient management practices on cacao (Theobroma cacao) yields in Solomon Islands

Simon Iro Sefa[1*], James Hanly[1], Paramsothy Jeyakumar[1], Nick Roskruge[1] and Chris Anderson[1]

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Cacao (*Theobroma cacao*), the second most important crop in Solomon Islands (SI) after coconut, is primarily grown by smallholder farmers for dried bean exports, which declined by about a third from 2011 to 2021. Whilst a range of development programmes have attempted to improve cacao production, these have not addressed nutrient management practices. Hence, this study aimed to assess the soil fertility status of cacao farms in SI (Guadalcanal and Malaita Islands) and to evaluate nutrient management practices that could give sustainable and economic yields.

A survey of 60 growers was conducted to gather information on farmers' current practices, including pruning, as well as on the soil and plant nutrient status of cacao farms. In addition, field trials were conducted at three sites, with contrasting plantation age and farming systems (monocropping and intercropping systems), to assess the effect of nutrient inputs on tree nutrient status and cacao yields. Conventional fertiliser nutrient inputs were used at two of the field trial sites, whilst organic nutrient inputs, derived from local food processing by-products, were used at the third field trial site.

Evaluation of Vanuatu peanut varieties for pod yield and aflatoxin

Floriane Lawac[1*] and Zhital Marai[1]

1 Vanuatu Agricultural Research and Technical Center

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Peanuts are widely grown across many islands in Vanuatu as a small-scale cash crop. Local varieties with little information about their introduction are grown predominantly as low-input organic crops. Peanuts are sold mostly as fresh produce in local markets, with smaller quantities going to processors located in Port Vila, and Tanna and Aore islands.

Previous reports and industry consultations suggest that aflatoxin contamination in Vanuatu peanuts is quite high, prohibiting the export of locally produced peanut butter to overseas markets. The low yield of current varieties and the association of aflatoxin with Vanuatu peanuts in the past limit potential growth of the peanut industry in Vanuatu.

In this study, the two most common peanut varieties in Vanuatu were evaluated in replicated field trials to assess their yield potential and postharvest aflatoxin contamination. Both varieties were planted on 13 July 2024; the Spanish variety was harvested early, on 15 October 2024, whilst the variety Runner was harvested late, on 25 October 2024. The peanut yield ranged from 1.10 to 1.52 t/ha, with no significant treatment effects due to varieties, seed treatments and interactions.

Current peanut varieties in Vanuatu give very low yields (1.5 t/ha, compared to the Australian national average yield of 4.25 t/ha), largely because of their susceptibility to leaf diseases (e.g. rust and leaf spot) and the lack of a seed quality control mechanism for peanuts in Vanuatu.

Assessing soil health indicators and nutrient status of two contrasting agroecological zones in Samoa

AnnJulie Johnson[1*] Md. Abdul Kader[1] and Ben Macdonald[2]

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2 Agriculture and Food, CSIRO, Australia
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Rainfall shows significant spatial and temporal variation across Samoa, even though it is a very small island country. Despite the importance of the spatial distribution of soil types, limited research has been conducted on the broad yield gap in taro production under Samoan conditions. Therefore, this research aimed to assess soil health variation in two contrasting agroecological zones in Samoa and to evaluate the effect of soil health variation on the taro yield.

Soil and taro samples were collected from 20 farmers in Samoa, 10 each in the dry and wet zones. Variation in soil health parameters revealed that the dry zone has a higher pH (6.6) than the wet zone (5.3). With respect to nutrient levels, the dry zone has higher exchangeable potassium (K) in the topsoil, whilst high levels of organic carbon (OC), total nitrogen (N) and Olsen phosphorus (P) were observed in the wet zone due to high biomass productivity, as well as increased soil organic matter content. Given its better soil health conditions, the wet zone exhibited significantly higher taro yields.

Regarding taro nutrient uptake, the wet zone demonstrated higher uptake of N and K, whilst no significant difference in P uptake was observed between the two zones, with P as a limiting nutrient in both zones.

The wet and dry zones of Samoa have different soil types, so agricultural productivity should be managed accordingly. The wet zone has higher taro yield than the dry zone and better soil fertility, which is critical for food security. The dry zone soils, whilst lower yielding, are also important but require careful management of crop residues to maintain soil carbon. They also require close monitoring of soil moisture to develop appropriate water-management strategies.

Effects of sustainable intensification practices on soil moisture levels of root crop systems in Samoa and Tonga

Faatoialemanu Areta[1*], Viliame Savou[1], Md. Abdul Kader[1], Leslie T Ubaub[1], Tevita Tukia[2], Soane Patolo[2], Dorin Gupta[3], Sineka Munidasa[3], Rainer W. Hofmann[4]

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2 MORDI Tonga Trust
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Sustainable agricultural intensification (SAI) is central to the development of climate-resilient production systems in Pacific Island countries. As part of a project for this purpose, we evaluated the effects of SAI practices on physical soil properties in cropping systems of Samoa and Tonga. The study focused specifically on soil moisture levels, which we measured using time-domain reflectometry.

After the establishment of a yam cropping trial in Tonga, soil moisture levels in November 2023 were 14% higher under mulching compared to weedicide treatments ($P < 0.001$). At the second harvest in June 2024, soil moisture levels under mulching were 60% higher than in the weedicide treatments ($P < 0.001$), supporting the hypothesis that mulching enhances soil moisture retention. Low soil moisture levels (16%) in weeded treatments indicated incipient drought stress. Non-tilled treatments under mulching had 16% higher soil moisture than tilled treatments ($P < 0.01$).

Intercropping also interacted with tilled treatments; a significant difference in soil moisture was observed between tilled and non-tilled treatments in non-intercropped plots, but not in intercropped plots, suggesting intercropping mitigates soil water loss in tilled systems.

At the first harvest in Samoa during May 2024, soil moisture levels were 3.6 units higher in mulching/spraying and sheep grazing/hand weeding treatments, compared to hand weeding alone, a 15% increase ($p < 0.01$). No significant effects on soil moisture were observed from the alley cropping treatments at the Samoan research site. There were also no significant treatment differences in soil moisture levels at the subsequent harvest in Samoa during January 2025, with all measurements exceeding 30% soil moisture, due to heavy preceding rainfall events.

These initial results will be compared with other physical soil characteristics and crop productivity traits. They indicate that SAI practices, such as mulching, enhance soil physical properties as demonstrated here by soil moisture levels, thus boosting climate resilience in Pacific farming systems. The interactions between tillage, intercropping, and soil moisture dynamics warrant further investigation to optimise SAI strategies for local conditions.

Increases in extreme dry season rainfall events could be having a negative impact on Vanilla flower induction in Vava'u, Tonga

Seini Tukuafu Fili[1], Amanaki Funaki[1], Solomone Vaikeli[2], Seluvaia 'Ilolahia [3], Lucia Ramos Romero[4], Bruce Smallfield[4*]

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2 Growers Federation of Tonga (GROFED), Tonga
3 Tonga Meteorological Service, Tonga
4 Plant & Food Research, Bioeconomy Science Institute, New Zealand
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Vanilla (*Vanilla planifolia* Andrews) is an important export crop for Tonga. A period of reduced rainfall is the normal environmental trigger to induce flowering. Growers also remove the growing tip of downward hanging stems to encourage flowering. Between 2017 and 2018, Vava'u experienced little or no flowering of vanilla. This coincided with periods of extreme rainfall (>90th percentile) during the flower induction and initiation period, leading up to the normal flowering period between September and November (start of the wet season).

Trials on commercial grower plantations assessing the impact of extreme rainfall on vanilla flowering were conducted during the dry seasons of 2022 and 2023. Three equivalent rainfall scenarios were compared – Normal (median long-term record for Vava'u), Variable (season control) and Extreme (> 90th percentile). They were applied in August of 2022 and extended to July and August of 2023. Weekly rainfall was used to determine the irrigation applied above rainfall for the Extreme. A clear plastic cover was used to exclude rainfall in the Normal treatment with weekly irrigation applied. Flower bud emergence was monitored between September and December. In 2022, the percentage of plants that flowered was 88% in the Normal, 50% in the Variable and just 38% in the Extreme scenarios. Plants in the Extreme scenario also produced 50% fewer clusters per stem than those in the Normal.

Plants developed severe stem rot symptoms near bean harvest, but the incidence was not aligned to a scenario. Bean rot was observed on the plants that had been irrigated (Normal and Extreme scenarios) but not in the Variable. In 2023, plants in the Normal also produced significantly more flower clusters per plant (6.5) than the plants in the Variable or Extreme (2.4). However, the time to reach maximum flower bud number varied significantly between the rainfall scenarios. Flower bud emergence stopped at the third week of October for plants in the Normal scenario but a month later for plants in the Extreme. With the frequency and intensity of extreme rainfall events becoming more prevalent and often associated with the La Niña conditions, Tonga vanilla farmers will need new crop management strategies to effectively induce flowering of their vanilla.

Session 1 Part 2: Sustainable agriculture systems

Chair: Dr Wee Tek Tay, Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation

The eradication plan of Citrus Tristeza Virus in two islands of French Polynesia

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Citrus Tristeza Virus (CTV) is a significant threat to citrus production around the world. The virus, located in the phloem of trees, leads to their decline and is transmitted by three aphids or by grafting with infected plant material. In French Polynesia, two archipelagos are still CTV free and allowed to host a citrus germplasm collection. However, CTV was detected in both collections. The eradication plan was based on mass sampling, detection with the immuno-printing technique, removal of CTV infected plants, zero plant material transfer in and out of the island, and monthly sampling surveys. After 12 months, no CTV positive samples were recorded, and the result was confirmed for at least six months. Together, these results show that the plan was efficient to eradicate CTV in the two islands and to preserve the citrus germplasm collection.

Seasonal abundance and host range of thrips (Insecta: Thysanoptera) in the eggplant (Solanum melongena L.) agroecosystems of Western Viti Levu, Fiji

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Eggplant *(Solanum melongena L.)* is a major horticultural export crop in Fiji, thriving in the island's tropical climate. However, its productivity is severely affected by thrips (Insecta: Thysanoptera), which causes direct crop damage and acts as a vector for plant pathogens. Climate factors and the diversity of host plants play a critical role in shaping thrips population dynamics, with weeds in eggplant agroecosystems serving as alternative hosts that facilitate thrips persistence and spread.

Despite the global significance of thrips as pests, studies on their eco-dynamics in tropical agroecosystems, particularly in Fiji, remain limited, hindering the development of context-specific pest management strategies. This study investigated the seasonal abundance and host range of thrips on six eggplant farms in Western Viti Levu, Fiji, during 2023, with a focus on climate seasons and host plants influencing their population dynamics. Statistical analysis revealed no significant difference in thrips abundance between wet/warmer and dry/cooler seasons ($p > 0.05$), but significant variations were observed among the six study sites ($p < 0.05$). Amongst the 40 weed species identified across farms, 45% (18 species) hosted thrips, representing 13 plant families, with Amaranthaceae supporting the highest proportion of thrips. Along farm boundaries, thrips were observed on 52% (40 species) of the 76 surveyed plants, including crops, weeds, fruit trees and ornamental plants, belonging to 16 plant families. The most common families hosting thrips were Solanaceae, Cucurbitaceae, Amaranthaceae, Asteraceae, Malvaceae and Fabaceae. True host plants, supporting all thrips life stages, were identified within Amaranthaceae, Solanaceae and Fabaceae.

These findings provide critical insights for farmers on which crops and weeds they should not have near eggplant agroecosystems to minimise thrips infestations. The study underscores the importance of understanding local environmental dynamics to develop targeted and effective pest management strategies in tropical agroecosystems.

Impacts of citrus black fly on lime production in Republic of the Marshall Islands: The case of Laura Village

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The origin of the citrus black fly (*Aleurocanthus woglumi*) can be traced back to Asia, from where it is believed to have spread globally in the early 2000s. It is an invasive species of insects that has had a devastating effect on the lime industry in Marshall Islands, where the disease it causes poses a threat to the overall food security in the region, as limes are a staple crop in the local diet. Over the last two years, farmers in the Laura village of Majuro Atoll have noticed the reduced yields and damaged fruits leading to a significant decline in their income but have been unable to identify the cause. However, it is suspected that citrus black fly is the cause after close examination of affected trees.

Despite the devastation caused by the disease, the government has not yet taken any action, which has left local farmers feeling frustrated and uncertain about the future of their citrus industry. They have been taking matters into their own hands by using natural methods to combat the disease and seeking support from NGOs and aid agencies. A coordinated and comprehensive response from the government, however, is crucial to addressing the long-term impact of the disease on the lime industry in the region.

Protecting the Pacific tree of life from the invasive coconut rhinoceros beetle: Current status and future directions

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The spread of the coconut rhinoceros beetle (CRB) in the Pacific region presents a significant threat to livelihoods and economies. Since the resurgence of this pest in the early 21st century, invasive strains, particularly those lacking the biocontrol virus (*Oryctes nudivurs*), have reached numerous islands, causing extensive damage to coconut and oil palm crops. In response, collaborative efforts have been initiated, such as the Pacific Response to CRB launched in 2019 by New Zealand's Ministry of Foreign Affairs and Trade in collaboration with AgResearch and the Pacific Community (SPC).

Initial containment efforts focused on defining pest distribution and developing effective biocontrol methods. However, CRB has continued to spread, with new invasions reported in the region. Genetic analysis has revealed considerable variation amongst CRB populations, with differing susceptibility to biocontrol measures. Whilst virus-based control strategies have shown promise in some areas, challenges remain, particularly in areas where CRB populations exhibit resistance to the virus. Complementary approaches, including the use of the entomopathogenic fungus *Metarhizium majus*, are being explored. This presentation discusses some of the ongoing efforts to manage CRB in the Pacific region and future directions.

Status of Sugarcane Smut (*Sporisorium scitaminea*) in Papua New Guinea after eight years

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Sugarcane smut, caused by the fungus *Sporisorium scitamineum,* is a serious threat to commercial sugarcane cultivation worldwide. In 2016, the detection of sugarcane smut in a commercial sugarcane field at Ramu Valley, Madang Province in Papua New Guiinea triggered a comprehensive and united response from the National Agriculture Quarantine and Inspection Authority (NAQIA), Ramu Agri Industries Limited (RAIL) and the local communities. The incursion was reported to NAQIA by RAIL and a Biosecurity Emergency Response was invoked by the Chief Plant Protection Officer (CPPO). A National Gazette was issued, declaring sections of the Ramu Valley a diseased area. Immediately after the disease was detected, RAIL began carrying out their mitigation plans in an effort to contain the sugarcane smut within the incursion area. NAQIA conducted a national delimiting survey to determine the national distribution of sugarcane smut. High priority

provinces were selected due to their proximity to the Ramu Valley and those sharing international borders with Australia and Indonesia. Awareness activities were carried out concurrently with the delimiting surveys throughout the country to inform the local communities about the disease.

The paper reports on the current status of sugarcane smut in Papua New Guinea, presenting findings from delimiting surveys conducted from 2016 to 2024, as well as general information on the integrated management activities carried out at RAIL to contain the disease. In 2022, sugarcane smut was observed on two closely related species, namely *Saccharum officinarum* (noble cane) and *Saccharum edule* (pitpit) in local gardens near commercial sugarcane fields within the Ramu Valley quarantine area. In 2024, further detections were found on S. *edule* at Yonki, Eastern Highlands Province, 35 km west of the initial incursion site.

Currently, sugarcane smut is mostly confined to the Ramu Valley in the commercial production areas and its surroundings, and most areas in Papua New Guinea are free from it. However, the ability of *S. scitamineum* to infect both *S. officinarum* and *S. edule* is of great concern, considering that these species are important subsistence food crops, as well as having cultural and economic importance in rural communities in Papua New Guinea.

Biological control in agriculture in French Polynesia

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Biological control, involving the use of pests' natural enemies, is one of the many solutions for natural pest control, which provides an alternative to pesticide use. In French Polynesia, various types of biological control are being developed: classical biological control (introducing an exotic natural enemy to control an invasive species), augmentative biological control (mass rearing and release of natural enemies), and conservation biological control (enhancing the activity of local natural enemies).

To manage invasive fruit flies, Bactrocera spp. (Diptera: Tephritidae), two parasitoid wasps, Fopius arisanus and Diachasmimorpha longicaudata (Hymenoptera), were introduced in the early 2000s from Hawaii, in partnership with the US Department of Agriculture. A rearing programme was established, and the wasps were released on infested islands. Currently, they are being produced and released into orchards at the beginning of the fruit season, complementing other methods, such as the destruction of infested fruits and the use of pheromone and protein bait traps.

A similar programme was conducted against the coconut hispine beetle, *Brontispa longissima* (Coleoptera: Chrysomelidae), which feeds on coconut fronds. The parasitoid wasp *Tetrastichus brontispae* (Hymenoptera) was first released in the 1960s on all islands where *B. longissima* spread over time. Currently, it is mainly released in new coconut plantations, because young coconut trees are heavily attacked. A future project will introduce the micro wasp *Asecodes hispinarum* (Hymenoptera) from Samoa, as it is much more effective and could ensure long-term control.

Regarding conservation biological control, trials have been conducted in vegetable crops to identify refuge plants for natural enemies. These plants should attract natural enemies by providing food and alternative prey, as well as offering shelter.

Finally, studies are being carried out to select and mass produce natural enemies already present in French Polynesia. The objective is to develop a range of natural enemies to control the major agricultural pests. Current efforts focus on aphid-eating lady beetles, aiming to develop mass-rearing techniques and release strategies, whilst also identifying and evaluating local entomopathogenic fungi.

Session 1 Part 3: Sustainable agriculture systems

Chair: Professor Md Abdul Kader, Discipline Coordinator, Agriculture and Food Technology Discipline, University of the South Pacific

Confirming the presence of symbiotic nitrogen-fixing bacteria (*Rhizobia sp.*) in the soil of Taro- (*Colocasia esculenta*) based cropping systems in Samoa

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Geographical isolation poses significant challenges for agricultural production in the Pacific region, including Samoa. This limits the availability and affordability of fertilisers, particularly N fertiliser, leading to low productivity and sustainability. One potential approach for improving soil health involves biological nitrogen fixation (BNF). This study used cowpea plants as a cover crop during the fallow period to confirm the presence of Rhizobia in the soil after taro was harvested during the 2023–2024 cropping season.

Three leguminous trees (Sesbania, Gliricidia and Erythinia) were grown as alley crops with taro to generate N-rich biomass for mulching to control weeds, along with hand-weeding, chemical control and sheep-grazing. At the flowering stage, cowpea roots were examined for nodulation and weighed, and nodules were counted, characterised and weighed. Nodulation occurred on cowpea roots in all plots, confirming Rhizobia's presence in the soil. The nodules were a determinate type, common to tropical legume plants. The root and nodule weight and number of nodules did not show statistically significant differences across treatments. The average nodule number varied from as low as 9.23 to as high as 32.97 per treatment, with an average nodule weight ranging from 0.18 g to 0.56 g per treatment. Most of the nodules were small.

These results, though preliminary, provide crucial information about the compatibility of weed management methods tested in the current project with the potential use of BNF in the region as an important component of sustainable crop intensification in taro production systems. The results of this experiment will be validated for the existence of BNF during the fallow period of 2025 and 2026 taro production, during which legumes will be used as a cover crop. Future work will also collect a robust dataset to evaluate the effect of weed management treatments on Rhizobia species. This work will potentially lead to a meaningful recommendation for Samoan taro farmers to use legume crops during the fallow period for improved soil fertility and crop productivity.

Effect of temperature and humidity on broad mite dynamics, feeding damage and arthropods associated with capsicum under protected structures in Fiji

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Broad mites (*Polyphagotarsonemus latus* Banks) pose a significant threat to capsicum grown under protected structures in Fiji, yet detailed information on their population dynamics, damage and interactions with other arthropods is lacking. This study addressed the information gap by measuring the population densities of broad mites for one growing season, by assessing feeding damage in relation to temperature and relative humidity, and by identifying other arthropods.

The results revealed that the densities of broad mite eggs (18.37 ± 2.50 per cm^2) and immatures (11.37 ± 1.64 per cm^2) are highest on young capsicum leaves three weeks after transplanting, with temperatures at 25.95°C and relative humidity (RH) at 74.4%. Adult broad mites (6.74 ± 0.44 per cm^2) peaked four weeks after transplanting at a temperature of 26.92°C and 71.4% RH. Significant negative relationships were observed between broad mite stages and temperature (eggs: p<1.2e-29; immatures: rho = p<2.0e-21; and adults: p<6.92e-07) as well as a moderately negative relationship with humidity (eggs: p<7.138e-11; immatures: p<2.624e-09; and adults: p< 2.36e-09). Broad mites were also observed on plants with no visible damage (DS0), but the highest egg (22.33 ± 3.46 per cm^2) and immature (13.35 ± 2.49 per cm^2) densities were observed on young leaves that were slightly curled (DS3). The highest adult density (6.77 ± 0.81 per cm^2) was found on young leaves that were all curled and bronzed with elongated petioles and deformed apical buds (DS5).

Other pests recorded include whiteflies, aphids, thrips and white-footed ants, with broad mites hitching rides on whitefly legs. Predators included lady beetles and predatory mites. The data suggest that the broad mite population is influenced by specific temperature and RH ranges, emphasising the need to align pest management with these conditions. Additionally, the variation in density across plant damage stages highlights the importance of early detection and intervention to avoid severe damage to capsicum plants. The results further highlight the need for adaptive and broad pest management strategies that are compatible with beneficial organisms under protected structures.

Knowledge gaps in forest genetic resources in Pacific Island countries and territories – A systemic review

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This review examines the sustainable utilization and conservation of forest genetic resources (FGR) in Pacific Island Countries and Territories (PICTs), emphasizing their critical role in fostering environmental resilience and economic sustainability amid intensifying climate change. FGRs support the adaptive capacity of forest ecosystems while providing essential goods and services–such as food, fuelwood, timber, medicinal resources, and cultural values embedded in knowledge systems. Drawing on peer-reviewed literature indexed in the ISI Web of Science and Scopus databases, this paper analyses studies incorporating the terms "forest", "plantation", and "genetic resources" to identify prevailing patterns and emerging trends in FGR research relevant to the Pacific region. The findings reveal significant gaps in institutional capacity and knowledge systems across PICTs, underscoring the urgent need for coordinated efforts to conserve and manage priority FGRs sustainably. This review advocates for the establishment of a centralized, accessible repository of FGR–related data to ensure that these resources continue to support ecological integrity, socio-economic development, and cultural continuity for future generations.

Oviposition patterns and egg mass composition of large cabbage moth, Crocidolomia pavonana on Head cabbage foliage in Samoa

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The large cabbage moth (LCM), *Crocidolomia pavonana*, is a major pest of Brassica crops, particularly head cabbage in Africa, Asia and Oceania, including Samoa. The larvae damage the cabbage plants by feeding on their growing points, reducing crop yield and quality. This study examined the distribution and oviposition patterns of the LCM eggs on cabbage plants in Samoa. This knowledge is important for implementing targeted pest control to minimise damage to non-target organisms in the field. The lack of this knowledge makes managing LCM challenging, often resulting in the inefficient use of any method of control and contributing to the build-up of LCM populations in the field.

Two planting cycles were carried out in 2024 to assess LCM distribution and oviposition patterns: from May to June and August to September. Three weeks after transplanting, 30% of cabbage plants were sampled to search for LCM egg masses. The location and egg clusters on cabbage leaves were counted and recorded. The results indicated that LCM oviposited 78% of the egg masses on the bottom parts of the foliage specifically, 45% towards the midrib, 31% towards the edge, 2% concentrated on the leaf stalk, and the remaining 22% were concentrated on the upper parts of the foliage,12% towards the edge and 11% towards the midrib.

The results also indicated that the number of eggs per egg mass was highest in the lower midrib (±426.1), followed by bottom leaf edges (±333), upper leaf edges (±136.3), and upper midrib (±104.1), while the fewest eggs per egg mass were observed on the leaf stalk (±20.7). This information will help cabbage growers develop an efficient methodology that directly delivers inputs like insecticide to where the insect pests are most probably found.

Survey and molecular detection of phytoplasma and its spread and distribution in Markham District of Morobe Province, Papua New Guinea

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The kalapua or marafri banana is a very significant staple food crop for the people of Markham Valley in the Morobe Province and other provinces in PNG. In 2017, this banana was reported to be affected by a disease that was causing wilting, yellowing in the leaves and unexplained poor development of the fruit in the Markham area. Following these reports, the National Agriculture Research Institute carried out surveys in late 2018 to early 2019 to investigate the cause and evaluate the spread and distribution of these unexplained symptoms. Symptomatic samples of kalapua and other plants collected during the surveys were tested for phytoplasma, using the loop mediated isothermal amplification (LAMP), with primers designed for phytoplasma. This was done at the National Agriculture Research Institute's Ghodake Biotechnology laboratory, in Lae, Morobe Province, PNG.

The LAMP assay identified phytoplasma, the new banana wilt associated phytoplasma (BWAP), on kalapua, yawa and jampu banana types. The pathogen was not detected in any other banana types and other plant species tested, Furthermore, the LAMP assay confirmed the occurrence and spread of the pathogen within the Markham District and some parts in the Nawae District. There was no detection in samples collected from the Huon district.

While this report will confirm the status of BWAP in kalapua, it will also show the spread along the main highland's highway from Watarais to Lae urban. It is important that effective management and control of this pathogen is done. This requires accurate and timely diagnosis for potential hosts and alternative hosts and the insect vectors. Hence, there is need for further work to understand the host, vectors and disease transmission within PNG.

Richness of weeds in the seed bank postproduction: Insights on the effect of different leguminous mulching materials and weed management approaches on soil planted with taro in Samoa

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The weed seed bank in soil plays a crucial role in weed ecology, influencing weed persistence and population dynamics in taro (*Colocasia esculenta*), a culturally and economically significant crop in Samoa. Short-term control methods, such as herbicide application, hand-weeding and mechanical interventions, often fail to address the weed seed bank effectively and can negatively affect soil health, the longevity of weed seeds and environmental sustainability.

This study assessed the composition and distribution of weed species in a field previously planted with taro and treated with various leguminous mulching materials and weed management approaches. Using the greenhouse method, 108 soil samples were analysed for weed species composition and seed distribution. A total of 22 weed species across 10 families were identified, with Poaceae (grasses) as the dominant family. *Axonopus affinis* (carpet grass) was the most persistent species, demonstrating its adaptability and competitive nature. Additionally, 71.43% of the identified species were perennials, highlighting their role in the long-term stability of the seed bank. A significant accumulation of seeds was observed at a depth of 10–20 cm, indicating the importance of deeper soil layers in seed persistence.

These findings highlight the importance of sustainable and climate-resilient strategies for managing persistent weeds in taro production. Understanding the soil weed seed bank can help farmers adopt targeted weed management practices that minimise herbicide use and improve soil health. This study provides critical insights that enable researchers and farmers to develop integrated weed management approaches suited to Samoa's agricultural systems. Additionally, this research aligns with regional efforts to enhance sustainable weed management strategies across the Pacific region, ensuring practical benefits for both farmers and researchers.

Session 2: Enablers of research

Chair: Professor Heather Worth, Director, Te Puna Vai Marama, Cook Islands Centre for Research, University of the South Pacific, Cook Islands Campus and Adjunct Professor, School of Population Health, University of New South Wales, Sydney

Higher education meets food systems thinking in the Pacific regions: A case study of agro-ecological connections between community and academia

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In the Pacific Islands, interest and investment in agricultural higher education have declined during recent years, partly as a result of shifting student preferences for education, aligned with evolving job markets. There is a noticeable trend away from traditional agricultural science programmes, which often confine students to specialised fields. At the same time, agricultural development and food system issues have become more complex globally and, in the Pacific region, require a more holistic approach and a workforce that possesses the diverse skills and experiences needed to integrate western sciences (biophysical and social) with Indigenous and traditional ecological knowledge, as well as skills in community participatory action research.

This study examines the state of agricultural higher education in the Pacific region by analysing programmes at the University of Hawai'i and the University of the South Pacific. In particular, it compares traditional agricultural science curricula with the Sustainable Community Food Systems programme at the University of Hawai'i, a multidisciplinary initiative launched a decade ago. Using an analysis of curriculum structures and testimonials from graduates across these programmes, the research explores how well they help realise the learning outcomes of an emerging signature pedagogy in sustainable food systems and prepare students for careers in agriculture, food systems and related fields. The findings highlight key lessons from graduates' experiences,

shedding light on the effectiveness of existing curricula and programmes in addressing societal, workforce and research needs.

This paper aims to stimulate discussion on the future of food systems education in the Pacific, with a focus on how higher education institutions can better align their programmes to the region's evolving agricultural and food system challenges.

Elevating and recognising Indigenous people's knowledge to improve forest biosecurity

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The forest biosecurity systems currently employed in many countries are largely based on western principles, values and scientific knowledge that have been introduced internationally. These systems are often devoid of the knowledge, as well as the underlying values and principles, held by Indigenous people, even those who have intimate and enduring relationships with their forests. Indigenous people also tend to be overlooked in policy and decision-making, even though they are often most affected by invasive pests infesting the native plant species on which they rely for sustenance and cultural or spiritual purposes.

Through an inclusive approach, scientists and Indigenous people can achieve more comprehensive and robust biosecurity outcomes that elevate and recognise the importance of Indigenous knowledge. A co-innovation approach can also result in more widespread adoption of tools or practices by end-users, including Indigenous people. Understanding New Zealand Māori and their unique knowledge base can help improve forest biosecurity systems and practices, as can discussions of barriers to inclusiveness. This presentation outlines key principles of Indigenous engagement, specifically the need to develop enduring relationships.

Enhancing TEK in agricultural practices: Lessons from Baelelea, Solomon Islands

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Traditional ecological knowledge (TEK) has figured importantly in agricultural systems of the Pacific Islands for generations. This paper explores TEK against the background of contemporary social and ecological changes, drawing on experience and stories from communities dependent on subsistence agriculture in Baelelea on Malaita Island in Solomon Islands. This paper is based on ethnographic fieldwork conducted on Malaita in 2021–2022 as part of the author's PhD dissertation research, as well as on prior knowledge of the region. Inland or mountain communities like those on Malaita have received only limited research attention, resulting in a research and knowledge gap. Additionally, research has focused more on agriculture than social and cultural dynamics, including traditional knowledge and people's lived experiences.

When new crops and varieties are introduced to meet economic and food security objectives, they are often accompanied by new farming practices and knowledge. These may have consequences that threaten the ecology and culture, raising concerns that locals describe as 'double trouble'. For the people of Baelelea, losing a native forest ecosystem also means the lamentable loss of culture and spiritual connection to the land, history and lifeways. Efforts to address climate change and food security in the Pacific through 'sustainable farming' and reforestation thus require a culturally

balanced approach that considers not just economic gain and food security but also the traditional knowledge associated with traditional crops and farming practices.

Exploring perspectives on land tenure in Tonga: A case study of Tongatapu

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The Kingdom of Tonga is unique amongst Pacific nations for preserving its traditional land tenure system since the 1875 constitution. Despite the cultural and historical significance of this system, scholarly exploration of land access, development and tenure has been limited, partly due to the topic's cultural sensitivity. Land ownership in Tonga is predominantly controlled by the monarch and nobles, leaving many commoners uncertain about land security, development and their future. Increasingly, they advocate for change in the land tenure system that respond to the requirements of contemporary livelihoods.

This study contributes to the literature on this issue by incorporating recent data and perspectives from various stakeholders in Tongatapu. It reviews the global context of land tenure, highlights Tonga's specific characteristics and analyses diverse perspectives on the issue. Data were collected through in-depth interviews with Tongans, using structured and unstructured questionnaires. Quantitative data were analysed with descriptive statistics, whilst qualitative data were examined thematically. Key findings reveal that most informants support maintaining the current land tenure system for its role in preserving social stability and cultural identity, particularly amongst rural, agriculture-based participants. However, a minority advocate for reforms to promote development and equal representation in land ownership. This study recommends fostering societal dialogue and awareness, as well as reviewing the land tenure system to better align it with Tonga's contemporary challenges.

Tapping into the potential of farmers living with disabilitie: An experience from Samoa

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Samoa's agricultural sector faces a growing workforce challenge due to urban migration and labour mobility schemes. This paper explores the potential of engaging people with disabilities, a historically marginalised segment of the rural population, to address this issue. Focusing on the experiences of Samoa's Women in Business Development Incorporated (WIBDI), we examine their targeted interventions, including direct employment of extension officers with disabilities and outreach to farmers with disabilities. The paper highlights the positive impact of these initiatives, demonstrating the value of inclusive employment practices and specialised support for farmers with disabilities. We analyse key lessons learned by WIBDI, offering practical guidance for other organisations in the Pacific Islands seeking to effectively engage and empower individuals with disabilities within the agricultural sector. This study contributes to a growing body of knowledge on inclusive development and offers a promising model for addressing workforce shortages while simultaneously promoting social inclusion.

Educational institutional approach through partnership for sustainable agricultural development: A case of Fiji National University

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The Fiji National University (FNU) has mandatory access to teaching, research and development (outreach). Given such a function, the College of Agriculture Fisheries & Forestry (CAFF) of FNU recently established the South Pacific Extension & Development Institute (SPEDI), as a mechanism for the university to reach out to the community to improve farming systems practised in rural communities by undertaking pluralistic extension methods using the educational institutional approach. Unlike other models, SPEDI's approach stresses improving farming systems using a holistic interdisciplinary approach with a two-fold focus.

The first focus is to understand the farming communities and improve their productivity in a sustainable way so as to increase income, improve nutrition, food security and livelihood enhancement training, and address climate change challenges. The second focus is to enrich the CAFF department's curriculum through teaching, research and extension. Global agricultural extension policies in recent times are geared towards improving farmers' livelihoods, not only in agriculture but also in addressing climate change issues and other sustainable livelihood activities. Hence, extension paradigms have changed and shifted towards more participatory and bottom-up approaches. SPEDI now aligns its model of approach towards such changes by partnering with Fiji Ministry of Agriculture and Waterways, farmer associations, funding agents, local and international institutions, and farming communities.

This paper presents the extension model of SPEDI and how it integrates with an existing international research and development project called Landcare. Landcare is funded by the Australian Centre for International Agricultural Research (ACIAR) and the above partners with the purpose of involving the wider Fijian communities and the Pacific region in agricultural research and facilitating sustainable agricultural developments focused on improving people's livelihoods and environment. Since involving itself with ACIAR's Landcare project, SPEDI has been instrumental in catalysing a transformative shift in agricultural practices across Fiji using SPEDI's extension model. By its collaborative efforts and emphasis on community engagement, the project has not only imparted vital knowledge and skills to local farmers but has also instilled a deep-rooted ethos of stewardship and sustainability. As we transition into the next phase with SPEDI, the legacy of Landcare through partnering will endure, serving as a beacon of sustainable development for generations to come, using the educational institutional approach. The project outputs from the communities will be used as input in teaching and research at the university.

Enhancing research in the Pacific through the Pacific Climate Change Research Roadmap 2025

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The Secretariat of the Pacific Regional Environment Programme (SPREP), through the Pacific Climate Change Centre, commissioned the preparation of the Pacific Climate Change Research Roadmap 2025–2036. The Research Roadmap 2025 is based on a review and analysis of the work

conducted between 2018 and 2024 and is relevant to the Research Roadmap 2018. The report on the review and analysis is published separately. The methodology used for that report consisted of a desktop review of the regional and national climate change projects and activities conducted between 2018 and 2024, virtual consultations with key stakeholders, two questionnaire surveys, and analysis and recommendations for the new Research Roadmap 2025.

The overall objective of the Research Roadmap 2025 is to enable transdisciplinary research to connect the communities responsible for climate change science research and climate change adaptation to contribute jointly to the improved safety, security and prosperity of Pacific Islands within the 2050 Strategy for the Blue Pacific Continent. The specific objective is to advance the underpinning climate change scientific and traditional knowledge research in the Pacific region and enable a people-centred approach for islanders to address the adverse effects of climate change.

There are eight pillars under the Research Roadmap 2025: (i) governance; (ii) climate change science; (iii) climate change adaptation and mitigation; (iv) traditional knowledge; (v) sector impacts and risks; (vi) capacity-building knowledge brokerage and communications; (vii) data and information management and (viii) climate finance. Three key approaches underlie the eight pillars and are to be incorporated throughout the implementation of the Research Roadmap 2025. The three approaches are: (i) the use of a transdisciplinary research to fully address climate change effects; (ii) the use of a people-centred approach incorporating the principles of gender equality, disability and social inclusion (GEDSI); and (iii) the uptake of the research information by the climate change adaptation and mitigation community by targeting individual consultative approaches for different users.

This paper discusses the objectives and methodology for the review and development of the Pacific Research Roadmap and the relevance of the key pillars to agriculture, forestry and fisheries sectors in the Pacific region. The roadmap covers a 12-year period 2025–2036 and is linked with the Intergovernmental Panel for Climate Change (IPCC) framework for the preparation of Assessment Reports (AR) 7 and 8. The new roadmap will focus on the decadal and multidecadal (next ten years to the end of this century) aspects of climate change research and its uptake by the adaptation and mitigation community.

Connecting-the-Va (space/gap): A framework to build relationships for effective partnerships and multi-disciplinary agricultural-climate-livelihood research in Pacific Island countries

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Pacific Island countries are facing complex systemic challenges, including climate change, unsustainable agriculture production, food insecurity, non-communicable diseases and poverty. Despite numerous north-south and south-south research partnerships aimed at addressing these challenges, many fall short due to a focus on institutional and research benefits over genuine collaboration, failure of partnerships, colonial top-down approaches and being labelled as extractive and manipulative research partnerships – therefore missing the opportunities to co-create knowledge and achieve higher societal impacts.

Drawing on a collective century of experience in north-south, south-south research partnerships and multi-disciplinary agricultural-climate-livelihood research in Pacific islands, we are presenting a new Connecting-the-Va Research Framework (VRF), which provides a structured approach to establish respectful and effective partnerships for multidisciplinary research in Pacific Island countries. We apply and demonstrate the VRF in the context of the ACIAR-funded projects, including conservation agriculture and sustainable intensification, and sustainable agriculture intensification for resilient development. These projects showcase how VRF can be applied and guide partnership development at multiple levels, from stakeholders to collaborations of individual researchers and disciplines. This is founded on the: (i) relationship-first approach to "connect the people (heart level) first" and build personal relationships, understanding and trust with people and communities in the Pacific islands, and traditional Pacific Island values before any conversations on research or institutionalisation happens; (ii) the second level – the body, "connecting the institutions", once trust is established, formalising institutional partnerships ensures accountability, transparency, and ethical integrity, built on the personal relationship and trust; and (iii) doing actual research, the "connecting the minds" component of this framework, where researchers from different institutions, communities and disciplines work together to plan and deliver systemic and multi-disciplinary research. Its vertical and horizontal applications will be presented to improve operationalisation of agricultural-climate-livelihood systems research and building solutions for societal problems in Pacific Island countries.

The changing role of women in the agriculture sector and their contribution to climate change mitigation and adaptation – A case study from Sigatoka and Ba, Fiji

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Given the vulnerability of Fiji's agriculture to the effects of climate change, urgent action aimed at mitigating and adapting to these effects is needed. Women have contributed significantly to Fiji's agri-business yet, historically, their contributions related to climate change and agriculture have been underappreciated. Women's agricultural expertise and traditions are helping communities adjust to these changes, but women frequently have less access than men to resources and technology, with less involvement in decision-making. Women's capacity to take an active role in and profit from initiatives to mitigate against climate change is further limited by social conventions based on gender and cultural barriers. By addressing the changing role of women in agriculture and supporting the claims with facts and figures from field research, one can draw attention to gender gaps in the workforce. Understanding how women's roles in agriculture are evolving and how they are affected by climate change is the main goal of this research, as women offer essential traditional knowledge, capabilities and practices related to climate-smart farming methods and natural resource management.

Session 3: Climate change

Chair: Ofa Kaisamy, Manager, Pacific Climate Change Center, Pacific Regional Environment Programme

Testing and adapting a Pacific collaborative regional research agenda: A case study examining Fijian farmers' challenges in growing sandalwood and other crops under changing climatic conditions

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Santalum yasi, a native sandalwood species in Fiji, is listed as threatened under the IUCN Red List due to overexploitation over the past 200 years. Sandalwood is a valuable commodity, and the Government of Fiji's Sandalwood Development Project aims to revitalise the trade. In addition to the native sandalwood species, two other species have been introduced in Fiji, *S. album* and *S. austrocaledonicum*. A fourth species is a hybrid between *S. yasi* and *S. album*. In a recent survey, more than 500 farmers were recorded to be growing sandalwood species on their land. Seventy-five of these farmers were interviewed over a period of three months and more than 50% of them recorded a change in climate and weather patterns in the past 10 years. Additionally, farmers recorded invasive species and fires as increasing problems in the past decade. The farmers also expressed a lack of support from the government on the promotion and farming of sandalwood. The Ministry of Forestry needs to be more proactive, raise more awareness and target the establishment of larger sandalwood farms (>2 ha). The Ministry of Forestry also needs to take a cue from the points raised by the farmers and carry out farm monitoring and farmer surveys on a regular basis.

Analysis of the key factors influencing farmers' crop selection in Rarotonga, Cook Islands

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Crop production throughout the Pacific region is fundamental to food security and supporting livelihoods. To sustain this industry, it is important to understand what is being grown and why, particularly in the face of climate change. This study analyses farmers' selection of crops and determining factors in Rarotonga, Cook Islands, using data from a regional survey conducted by PHOAFS Regional Research Agenda partners. A random sample of 174 farmers was surveyed in August–September 2024. Descriptive and bivariate analyses were employed. Generally, tree and fruit crops were the most common (44% of all crops), with taro being the most common root crop type (8% of all crops). Farmers were driven by factors such as dependability (82%), yield size (76%) and local demand (70%) in their crop selection. Significant differences were found between commercial and subsistence farmers in their crop profile, crop diversity and reasons for crop selection; commercial farmers were predictably more influenced by economic factors. Notably, results show that changing climates have relatively little effect on farmers' crop selection. These findings give a profile of crop production in Cook Islands and have implications for climate and agricultural planning, where farmer priorities must be considered in adaptation and resilience strategies.

Nauruan farmers' perceptions of government support for resources and guidance

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Food security in Nauru depends heavily on the resilience and productivity of local farmers. This study aimed to explore the challenges faced by farmers, their adaptation strategies to climate change, and their perceptions of government support. Data were collected using surveys administered on World Food Day, targeting 25 active farmers in Nauru. The findings revealed mixed perceptions of government support. While most farmers with less than three years of experience reported feeling well-supported, more experienced farmers expressed dissatisfaction. This disparity stems from a perceived lack of tailored support for advanced farmers, who require resources and guidance to expand into commercial farming. These experienced farmers hold significant potential for developing Nauru's agricultural sector, yet their needs remain unmet. This study underscores the importance of understanding and addressing the specific challenges faced by experienced farmers. By identifying gaps in support and tailoring interventions, the government can foster sustainable agricultural growth and strengthen food security in Nauru.

Climate challenges in New Caledonia: Tackling salinity and its effects on the Pacific's principal staple crop, taro (*Colocasia esculenta* (L.) Schott)

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Taro, a vegetatively propagated root crop, is widely cultivated in the Pacific Islands, providing a key staple food. The region faces major environmental challenges, including increased cyclonic activity, leading to tidal inundation, together with the threat of rising sea levels due to climate change. Low-lying islands already experience elevated groundwater salinity, which adversely affects the production of crops such as taro – a trend expected to worsen in the future. Despite the culinary and cultural significance of taro in the Pacific, limited research has been conducted on this species. It remains unclear whether there is sufficient genetic diversity for salinity tolerance that could be harnessed through crop improvement. Previous studies have suggested that wild taros from New Caledonia differ genetically from the widely cultivated Pacific taros and appear to be genetically distant from other wild taros in Melanesia.

The objective of this ongoing study is to develop a straightforward phenotyping system to screen local Caledonian taro varieties for salt tolerance. The method is based on an affordable hydroponic pot system, previously developed for phenotyping drought stress. This system simulates environmental conditions typically observed during tidal inundations or salt infiltration into groundwater. Preliminary results allowed us to assess the effects of different growing media on taro growth and their responses to varying levels of salinity by adding NaCl to the irrigation solution, ranging from 0 to 150 mm.

The overall aim of this project is to identify salt-tolerant taro genotypes suitable for cultivation in the Pacific territories and to support regional taro breeding programmes in generating improved cultivars that are both resilient and nutritious. This paper highlights a successful regional partnership fostered through a French Pacific-funded project coordinated by the Secretariat of the Pacific Community's Centre for Pacific Crops and Trees (SPC-CePaCT), in collaboration with New Caledonia (IAC, Technopole) and Australia (University of Queensland). Unique taro varieties from this project will be added to CePaCT's collection, marking the first collaboration of its kind between these institutions – an initiative we hope to extend to all the Pacific region.

Factors influencing farmer's crop production decisions under changing climatic conditions: A case study from the Eastern Highlands Province of Papua New Guinea

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Climate change contributes to significant environmental degradation, leading to a decline in fresh food sources, along with gradual deterioration in the quality of nutrition and livelihoods. In Papua New Guinea, this phenomenon has adversely affected food security over the past decade for about

80% of households relying on agriculture. This study explored farmers' experiences of climate change, its effect on food crop production, and factors that guide the use of adaptation measures to improve food and nutrition security. Data were gathered from a survey involving 264 farmers in the country's Eastern Highlands Province. The results show that households give priority to crops grown for food and economic benefit. Moreover, agronomic factors have a predominant influence on crop selection and production. Farmers' decisions are based mainly on profitability and market demand, environmental suitability (including land quality), crop maturity time, crop resilience to unpredictable weather, pests and diseases, high-yielding varieties, and availability of sufficient capital to grow crops. Furthermore, farmers still employ traditional agronomic practices and report insufficient knowledge and awareness of climate change and improved agronomic practices. Additionally, limited resources and lack of support systems have hindered progress towards climate change adaptation.

Economic factors in crop selection and farming methods in response to climate change in Tonga

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Agriculture plays a significant role in Tonga, contributing 20% to GDP, employing 27% of labour force and sustaining livelihoods across the kingdom. Pressing issues such as climate change, economic and market shocks and rising labour mobility hinder the growth of the sector. This study aims to understand factors influencing farmers' crop selection in Tonga by examining market demand, production costs and adaptability to climate conditions.

A survey was carried out on Tongatapu, between August and October 2024. The survey captured 112 farmers' perceptions and adaption to the effects of climate change on crop production. The findings show that farmers prioritise crops that are not only profitable but require minimal input and are suited to environmental conditions. Root crops and specific fruits that meet these criteria are preferred choices. These selections reflect a balance between economic viability and environmental sustainability. Moreover, farmers have adopted both traditional and modern farming methods to adapt to climate change. The methods selected were mainly based on the return for efforts, which incorporate crop selection, management requirements and market value. The research highlights the need for targeted agricultural policies that support farmers in making economically sound decisions without compromising resilience. Such policies would provide a pathway towards sustainable agricultural practices that address both local needs and global challenges.

Aka'tika Uira (Realign the Wheel): An analysis of the climate adaptation methods adopted by farmers in Rarotonga, Cook Islands

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Climate change is already a critical issue for Pacific nations and threatens the ability of local farmers to produce crops. Despite this, farmers have been historically left out when it comes to research.

Understanding Pacific farmers' experiences of climate change, the way they adapt in response, and the challenges they face in sustaining their production is essential for adaptation. This study analyses the adaptation methods used by farmers in Rarotonga, Cook Islands, using data from a survey conducted by PHOAFS Regional Research Agenda partners across multiple Pacific countries.

A sample of 174 farmers was surveyed during August and September 2024. Farmers reported experiencing inconsistent rainfall (49%), rising temperatures (50%) and increasing frequency and/or severity of droughts (49%). Most farmers (87.9%) had made at least one adaptation method in response to changing weather patterns and were more likely to adapt in response to increasing drought conditions. The major adaptation methods implemented by Rarotonga farmers were crop and soil management methods (52% of all adaptations), such as crop rotation, mulching, and composting. Contrary to other research, there were no demographic factors influencing farmers' likelihood of adapting to climate change effects. By centering farmers' experiences, this research offers context-specific insights to support more inclusive and meaningful climate adaptation plans, policies and solutions.

Investigating crop responses to slightly saline irrigation: A research collaboration on desalination and agriculture

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Historically, desalination technology has primarily been used to address drinking water shortages, with limited attention given to agriculture. However, given the increasing frequency of extreme events such as droughts, we have begun exploring novel solar-driven desalination technologies to support food systems. Most modern desalination technologies cannot achieve potable-level desalination but with a salinity removal rate of 90–95%, they may still be suitable as a drought mitigation solution for agriculture.

While the engineering team at the Australian National University (ANU) focuses on developing such emission-free desalination technology, the ANU Institute for Climate, Energy and Disaster Solutions (ICEDS) research team has led a collaborative project with the Tongan Ministry of Agriculture, Food and Forests (MAFF) to study the effects of slightly saline irrigation on key Pacific crops such as taro and yam. Our first experiment examines the impact of various levels of salt impurity in irrigation water on taro (*Colocasia esculenta*) growth and productivity. We used a randomised complete block design with four treatments: no irrigation (rainfall only), groundwater irrigation, low salt (3–4 dS/m), and high salt (6–7 dS/m), applied weekly for 38 weeks. Leaf and corm masses, stomatal conductance, chlorophyll concentration and dry matter content were measured to investigate whether there were any significant differences between the four treatments. Salt levels were chosen to simulate levels achievable by modern emission-free desalination, with the low and high salt treatments representing 5% and 10% of seawater salinity, respectively.

This research will help to inform Pacific farmers on the salt tolerance of common crops and is an important step in testing the utility of modern desalination technologies in agriculture. This collaboration has brought together the ANU ICEDS and MAFF research teams, allowing them to work side by side in the field, exchange knowledge and practical expertise, and lay the foundation for future partnerships in Tonga and the broader Pacific region.

Session 4: Food security and nutrition

Chair: Dr David Teulon, Principal Scientist, Invasive Species – Asia Pacific, Plant and Food Research and Adjunct Professor, Lincoln University

Tonga Circular Economic System

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The Tonga Circular Economic System (TCES), initiated by the Ministry of Agriculture, Food and Forests (MAFF) in 2018, is a sustainable closed-loop zero-waste recycle system. That is, TCES is a cycle of maize locally produced as feed for broiler poultry farms to supply poultry meat for Tonga. The broiler farm's waste plus maize silage is fed into a biogas facility, producing biogas to fuel generation of electricity and thermal energy. The waste from the biogas facility is recycled as organic fertiliser for the production of maize.

There are four projected outputs of TCES. First, an annual supply of 3,500 kilo-Watt electrical energy and 3,500 kilo-Watt thermal energy generated by methane biogas. The 3,500 cubic metre biogas produced will replace the annual import of about 7.7 million litres of diesel fuel valued at about TOP 26 million. The thermal energy produced will power air conditioners, cooling facilities, industrial dryers, etc., valued at about TOP 26 million too. The second output is an annual supply of 3,000 tonnes of poultry meat valued at TOP 32 million based on the production of 2 million broiler chickens by 200 poultry farmers. The third output is an annual supply of 10,000 tonnes of maize grain for livestock feed valued at least TOP 8.5 million produced from at least 2,300 acres of maize by at least 200 farmers. The fourth output is an annual supply of 4,375 tonnes of dry organic fertiliser valued at least TOP 0.33 million produced from the biogas operation to sustain the soil fertility for maize production.

The TCES projection outputs will substantially transform Tonga's deficit economic situation by significantly reducing the import of fossil fuels for electricity and replace them with biogas fuels associated with extra thermal energy and much less emission of greenhouse gas. Furthermore, half the annual import of about 6 million kilograms of frozen poultry meat pieces will be replaced by local, healthier fresh whole poultry meat. The import of livestock feed will also be replaced

by the locally produced maize grains and also provide feed the pigs. The huge import of mineral fertilisers will be replaced by the organic fertiliser produced by the biogas operation. Hence the TCES transition of Tonga's economy will drive an equitable, prosperous, fully sustainable, and largely self-determined circular economy.

In an improved economic situation, the 2024 huge remittance of about TOP $500 million from the Tongan diaspora overseas will not pay for Tonga's huge import of fuel, food, fertiliser and feed, but will be invested in Tonga's industry, agriculture, fisheries and tourism. Hence the economic transformation, will in the future, prevent the huge loss of Tonga's human resource capital to the seasonal labour scheme in Australia and New Zealand.

A farm business planning approach to increase profitability and productivity of smallholder cattle farming in Vanuatu

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Approximately 50% of rural households in Vanuatu raise cattle, which are important for social cohesion, community nutrition, income generation and savings for smallholder households in rural Vanuatu. The country's geographic and climatic conditions, together with its disease-free status, create favourable conditions for beef production. Despite this, the national cattle population and beef production are in decline. Increased productivity in the smallholder subsector could contribute significantly to national beef productivity and the livelihoods of smallholders. The *Bisnis Blong Buluk* project, funded by the Australian Centre for International Agricultural Research, has worked on Espiritu Santo and Malekula to develop an integrated approach for enabling smallholder cattle farmers to develop and implement cattle farm improvement plans, leading to more productive, sustainable and profitable beef production businesses.

The approach integrates business planning, household budgeting and technical capacity building through Buluk Farmer Field Schools. The business plans include situation analysis and farm mapping, risk management and visioning, culminating in the development of medium-term operational plans. Training in household budgeting strengthens financial literacy skills required to develop and monitor household income and expenditure, including from the cattle business. Buluk Farmer Field Schools provide farmers with technical skills and knowledge that enable them to make more informed decisions about the development and implementation of their cattle farm improvement plans.

The schools have conducted 11 small research trials and have delivered over 40 special topics with 10 farmer groups. The methodologies and materials have been pilot tested, evaluated and refined at field days and community events on Espiritu Santo and Malekula, and with 10 farmer groups over the past two years. Over 100 households are now implementing various parts of their business and operational plans, utilising household budgeting and technical knowledge and skills to improve their cattle farms and livelihoods. The methodologies and materials have been disseminated to banks, training providers, farmer associations and funding agencies.

The approaches and outputs can be adapted to commodity production systems other than cattle and have been adapted for households producing small ruminants on the island of Malo. The project has developed a facilitators manual, business plan templates and household budgeting training materials, whilst also delivering master classes on cattle farm business planning to future users of the approaches and outputs. Monitoring of the use of these plans by farmers and facilitators is now in progress.

Agroforestry for strengthening rural livelihoods in Fiji

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Livelihood capital (which encompasses physical, financial, natural, social and human resources) profoundly influences the resilience and well-being of rural communities, shaping their farming strategies, income diversification, and adaptation to environmental and economic challenges. Understanding how these resources influence diversification strategies is essential for addressing food security, gender equality and vulnerability to climate change.

This research compares the livelihoods of conventional farmers (CFs) and tree-based farmers (TBFs) in Fiji. Using data collected from a structured questionnaire, the study employed the sustainable livelihood model (SLM) to assess differences in livelihood capital between CFs and TBFs in Sigatoka, Labasa and Taveuni. Compared to CFs, TBFs showed statistical differences in most indicators of natural capital, and some indicators of physical, financial and social capital. TBFs contributed to better natural capital following sustainable practices such as tree planting and protection. They had greater access to assets like smartphones and transport which improved farm productivity and marketability. They also had higher annual incomes and were more likely to own land, further increasing their economic security. In addition, they were more represented in both farmer and youth groups (where most activities involved planting of native trees and solesolevaki), despite having fewer training opportunities than CFs. In terms of human capital, both groups had similar access to education and labour. These findings highlight the benefits of agroforestry in transforming rural livelihoods, whilst also emphasising the need for policy interventions to foster tree planting in agricultural landscapes across Fiji and the Pacific region.

Development of mass propagation system for elite varieties of kava (*Piper methysticum* G. Forster)

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Kava *(Piper methysticum*) has high social, cultural and economic value in Pacific Island countries. It has healing, analgesic qualities and is consumed as a beverage for social gatherings and to induce relaxation. There is a growing international market for it as a dietary supplement for relaxation and anti-anxiety uses. The establishment of adequate, disease-free, decent quality planting material is a significant constraint for commercial kava enterprises in Fiji, where there is a serious production decline as a result of the kava dieback disease, caused by the cucumber mosaic virus (CMV).

This project investigated effective mass propagation techniques for generating disease-free planting materials of elite varieties – Yonolulu (leka), Yalu, Matakaro balavu and Dokobana loa – using virus testing, nodal propagation, and tissue culture. Healthy and CMV-infected kava plot soil samples were analysed for macro and micro-nutrients to find out if tolerance or resistance to CMV is due to an absence of CMV and not any site-specific characteristics.

The levels of nitrogen, phosphorous, potassium, magnesium, calcium, zinc and iron were significantly lower in plots with CMV positive plants. Nutrient deficiencies affect various plant defense mechanisms that control CMV infection and/ or the level of infection. Plants free of

CMV were used to find an optimised method for vegetative propagation using stem cuttings with various formulations of substrates. Findings show that single node propagation methods had 100% success, while two and four nodes propagation methods had 83% and 67% rates respectively. Substrate combination of 40% loam soil, 30% garden compost and 30% river sand was found to be the optimum for kava propagation. Shoot tips were extracted from three months old CMV negative plants for in vitro regeneration. A combination of full-strength MS basal medium supplemented with 1.5 mg/L BAP, 0.5mg/L GA3 and 0.5mg/L IBA proved the best shoot initiation and elongation medium. Optimum rooting was achieved on full strength MS, supplemented by 1.0mgL-1 IBA, 0.5mg/L BAP and 0.5mg/L GA3 with 82% success. The in vitro protocol developed and described herein is reproducible with minimal hormonal supplements, and results in faster and true-to-type plantlets fulfilling current commercial farming and pharmaceutical demands.

Rekindling local production of makmōk (*Tacca leontopetaloides*) starch in the Marshall Islands

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Ṃakṃōk starch, traditionally derived by extraction from mature makmōk tubers, is widely regarded as a famine food in Republic of the Marshall Islands (RMI). Commonly known as Polynesian arrowroot (*Tacca leontopetaloides*), the crop normally grows well on tropical islands, including RMI. Within RMI, reports indicate that it was a popular source of starch up to the 1940s but then became unpopular and underutilised, as food preferences shifted to crops suh as cassava and sweet potatoes. Little is known about the importance of makmōk starch or its use as food, except among people in the outer islands, particularly elderly people with experience in farming, harvesting and processing the crop. There are also limited data and information on its feasibility for mass production and trade in local and global markets.

The purpose of this research was to collect data and information on recent production, along with traditional knowledge, to improve the safety and suitability of the end-product for human consumption. A further aim is to promote the re-introduction of makmōk starch to local communities, given its rich history on RMI and its health benefits as a food source. In addition, this research could encourage current and emerging entrepreneurs to produce and promote acceptance of the starch as an important source of income, particularly for marginalised community members, such as unemployed youth and women or single mothers.

Developing a combination of pressure washing and hot-water treatment for taro exports

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Taro exported to New Zealand from the Pacific Islands is fumigated with methyl bromide (MB) to

control mites, nematodes, snails and other quarantine pests. There are growing restrictions on the use of MB, such as the need for recapture. In response, we have developed an alternative treatment that combines pressure washing (PW) followed by hot-water treatment (HWT). In Samoa, we treated mites (*Rhizoglyphus minutus*) and nematodes (*Meloidogyne* sp. or *Helicotylenchus* sp.) with HWT alone, both 'on' and 'off' taro. A series of HWT trials on taro quality examined temperatures and durations, ranging from 45° to 55°C for up to 35 mins alone and in combination with PW. Taro was packed in sacks and stored for up to three weeks at 10°C. Pressure washing of taro included 12–15 seconds on rolling brushes, which was found to be a highly effective cleaning method with minimal damage to the taro. After a series of trials, a final combination treatment of PW at 50 psi (3.45 bar) followed by HWT at 48°C for 25 mins and subsequent hydrocooling and air-drying was determined to be the optimum treatment.

Cutting the 'parent base' off each taro served as a further mitigation measure, removing the area most likely to contain rots and pests. Ten semi-commercial shipments of 600 taro were exported to New Zealand and inspected by quarantine staff on arrival to validate the efficacy of the combination treatment. No unwanted organisms were found. Untreated taro (in the same shipping container) was found to contain mites and/or nematodes, and fumigation was required before the taro was released. Further work was undertaken to determine the efficacy of the PW/HWT treatment protocol on leaf blight (*Phytophthora colocasiae*), with the aim of accessing the Australian market. Initial trials showed effective control, and the protocol was approved by the Department of Agriculture, Fisheries and Forestry (DAFF). A commercial design for PW and HWT was developed, and steps towards commercialisation are ongoing.

Understanding consumer perceptions of and preferences for organic produce in Tonga

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Organic agriculture helps maintain a balance among living things in the natural environment. With this benefit, however, often come costs. Transitioning to organic agriculture requires a balance between costs and benefits derived from increased market share. The Pacific region – Tonga in particular – faces challenges resulting from limited information on market preferences and demand. Greater knowledge of the market for organic produce would better enable farmers to calculate the return from their efforts, as they transition to organic crop production.

This study evaluated consumers' willingness to buy organic produce. To this end, a survey was carried out during July-August 2024, targeting consumers above the age of 18 years in Vava'u and Tongatapu. The results show that consumers are willing to buy organic produce mainly for health reasons. Consumers further perceive organic produce as 'chemical free' and natural. The main hindrances to purchasing organic produce are factors such as availability, price and traceability. Although the majority of respondents said they do not purchase organic produce, most indicated interest, should the opportunity arise. These findings provide useful insights into consumer preferences for organic crops, which can inform initiatives and public awareness aimed at promoting organic farming amongst consumers, farmers, funding partners and policymakers.

Session 4: Food security and nutrition (continued)

Chair: Dr Steven Crimp, Research Director, Australian Centre for International Agricultural Research

The diversity of taro – a key indicator of climate-resilient food in the Pacific region

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The genetic variation of crop species is key to the long-term resilience of food systems, providing the base for adaptation to future climate scenarios and threats. Taro, a key staple in many countries of the Pacific, is central to local food security. Since the crop's genotypic and phenotypic diversity are not necessarily correlated, genetic research is required to assess the state of this crop. The first key aim was to assess the CePaCT (Centre for Pacific Crops and Trees, Suva, Fiji) collection for duplication and thus increase the efficiency of maintaining this holding. The second aim was to examine the diversity of the collection and assess key traits, such as resistance to taro leaf blight (TLB), as indicators of future resilience.

Microsatellite markers were chosen for this project due to their high polymorphism (variation between samples) and the ease of analysing subsequent samples in batches over time. We also employed flow cytometry to determine the ploidy for a subset of samples to assist with data interpretation. Of the 1,319 samples analysed, 183 clone groups comprising 793 samples were identified. Amongst the remaining unique genotypes, six key clusters were identified.

Material originating from collections in Indonesia, Papua New Guinea, the Philippines and Fiji had samples in all clusters, whilst French Polynesia, Hawai'i, India, Japan, Malaysia and Tonga had samples in only one or two clusters. More variation was found in samples within countries than between countries, reflecting a high degree cultivar sharing across the region. Diversity statistics

were low, indicating a narrow genetic base for taro. The highest values were for Indonesia, the Philippines and Vietnam, whilst the lowest were for Niue, Palau and Solomon Islands.

Market surveys of taro in Fiji showed that most cultivars are represented in the CePaCT collection, whereas only one cultivar from the Samoan market samples was held by CePaCT. The Fijian market samples appear to be vulnerable to TLB and likely other related diseases, while the Samoan market samples correlated well with TLB-resistant accessions.

Assessment of seven Fijian taro (*Colocasia esculenta* (L.) Schott) varieties for drought tolerance

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Drought tolerance is essential for improving taro (*Colocasia esculenta*) cultivation in water-scarce environments, particularly in regions such as Fiji, where taro is a vital staple and economic crop. Limited knowledge exists of drought-tolerant taro varieties.

This study evaluated the drought responses of seven taro varieties using total plant biomass (TPB), water use efficiency (WUE), root-to-shoot ratio (R:S), and stress index (SI) under both well-watered and drought-stressed conditions in a controlled screenhouse experiment. All varieties exhibited reduced TPB under experimental drought, with *Matadrala* and *Tausala ni Samoa* experiencing the steepest declines (45% and 41%, respectively), highlighting their susceptibility. *Tarova Loa* and *Uro ni Vonu* stood out for their higher WUE, with *Tarova Loa* achieving a 12.4% increase under drought. However, these varieties also faced limitations, including reduced TPB and lower R:S ratios, which may hinder long-term resilience. In contrast, *Tarova Damu* and *Tarova Vula* demonstrated a balanced combination of traits, including low SI values, modest biomass reductions, and enhanced root allocation, indicating stronger drought tolerance through adaptive root development.

These findings reveal significant variation in drought responses among taro varieties, providing valuable insights for breeding programmes aimed at enhancing resilience in drought-prone environments. While some varieties demonstrated drought-avoidance strategies, further research is needed to improve their overall adaptability and performance under severe stress conditions. This study provides insight into the response of seven Fijian taro varieties to stimulated drought, offering guidance for future drought screening programs as well as knowledge on some locally adapted varieties.

Building social resilience and food security through sustainable agriculture intensification in Samoa and Tonga

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Pacific Island states face significant challenges to food security and social resilience due to climate change, limited arable land, and high rates of non-communicable diseases (NCDs) linked to imported, nutrient-poor foods. This research examines how sustainable agriculture intensification,

specifically through keyhole gardening and agro-ecological practices, can enhance local food security and health outcomes.

Keyhole gardens are small, raised beds that are easy to maintain and ideal for growing diverse, nutrient-rich crops. They are highlighted as a valuable tool for household food production. By enabling families to grow fresh produce all year with minimal resources, keyhole gardens support dietary diversity and have the potential to reduce reliance on imported processed foods, thus addressing one of the root causes of NCDs, such as diabetes, hypertension, and cardiovascular diseases.

This study integrates traditional agricultural knowledge with sustainable techniques to promote resilient local food systems that bolster both environmental health and community well-being. Case studies from the region demonstrate how such methods reduce food insecurity, mitigate the prevalence of NCDs through improved nutrition, and empower local communities. The findings provide a policy framework aimed at promoting sustainable agricultural development, enhancing food system resilience, and building socio-economic resilience across Pacific Island states. Ultimately, this research outlines pathways for the Pacific Islands to build sustainable, resilient food systems that can withstand environmental and socio-economic shifts while promoting public health, and investigating local consumer attitudes, habits and preferences for sheep meat in Samoa.

Investigating local consumer attitudes, habits, and preferences for sheep meat in Samoa

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This research explores consumer attitudes, preferences and other factors influencing sheep meat consumption in Samoa, The research aims to reduce reliance on imported, high-fat meat that is associated with NCDs by promoting locally produced sheep meat. Whilst Samoa's sheep population has increased since the first flock was introduced in 2004, imported sheep meat remains dominant in the market.

The study was conducted across the islands of Savaii and Upolu. Face-to-face interviews with 10 local sheep farmers, 10 distributors and 100 consumers were conducted. Using both qualitative and quantitative research methods, the study gathered data through structured interviews and consumer questionnaires. The results showed that leanness is the most preferred characteristic for both imported and locally produced sheep meat. Price (91%) and quality (82%) were identified as the primary factors influencing purchasing decisions, with 30% of consumers also considering meat safety, freshness and animal age as important, whilst only 2% regarded animal sex as a relevant factor.

The study further determined that consumers prefer to purchase meat from supermarkets, valuing convenience, trust in the quality of the meat and competitive pricing. Notably, 46% of participants suggested that the Ministry of Agriculture and Fisheries should create awareness programmes to educate consumers on the benefits of local sheep meat. Additionally, sharing of farmers' experiences was proposed as a practical strategy to promote local sheep meat.

The findings provide valuable insights for policymakers, investors and stakeholders in the sheep meat supply chain. The study also highlights the importance of providing safe, healthy and affordable meat options that benefit both consumers and producers. Finally, it underscores the critical role of regional research partnerships in addressing Samoa's dependence on imported meat and in fostering a sustainable local meat market.

Characterisation and modification of pectin from Samoan citrus (Tahitian lime and local mandarin) for potential value addition and health promotion

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Waste generated by agro-processing and mismanagement of postharvest fruit processing pose serious waste management challenges, leading to health hazards and environmental pollution. This should be addressed using a holistic approach. Citrus peel, whilst accounting for much of agro-processing waste, is surprisingly rich in valuable compounds (including pectin) that can be valorised. Pectin is well known for its use as a gelling, thickening and stabilising agent in food products. It is also used to promote digestive health, cholesterol management, blood sugar regulation, weight management and prebiotic effects. Valorisation of citrus peel waste to obtain pectin helps promote circularity of primary resources, whilst promoting sustainable agricultural practices and creating income opportunities for rural communities.

This study aimed to extract, characterise and modify native pectin for value addition and health promotion. Pectin studies have been conducted internationally but not in Pacific Island countries, including Samoa. This presentation describes the methodology and literature review for a study of extracted native pectin products and notes the relative importance of data collected for food and health promotion. The study's characterisation and modification approach include proximate analysis, yield, DE, DM and DAc, Mw and rheology. Pectin was extracted by means of a computer-aided engineering method from powdered citrus peel to enable thorough comparison with pectin of different origins, using the available technologies. High-performance liquid chromatography, Fourier transform infrared spectroscopy, rheometer and texture analyser were used for structural and rheological confirmation. Results on the characterised evidential values support structure-function relationships, with the domains HG, RG-I and RG-II allowing diverse applications. The information collected provides evidence-based data for quality control and manufacturing. The baseline data can be used for further studies, mainly on modification, to enhance nutritional benefits and promote food and pharmaceutical innovation for new applications.

Dilution of commercial feed with cassava (*Manihot esculenta*) root meal in combination with moringa (*Moringa oleifera*) and mulberry (*Morus alba*) leaves for crossbred chickens

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The experiment investigated the effects of partial dilution of commercial grower feed (CF) with cassava root meal (CR), mulberry leaf (MLM), moringa leaf meals (MOL) in combination with added vegetable oil (VO) in crossbred chickens. A total of 64 birds aged eight weeks, were weighed individually and assigned to 16 deep litter pens, each containing four birds.

Four diets were prepared to be isocaloric and isonitrogenous. Diet 1 (control) was 100% commercial pullet grower feed from Mainfeeds Ltd, New Zealand. In the test diets, commercial feed was diluted at 60% with a combination of CR, MOL and VO. Diet 2 was 40% commercial feed

mixed with 15% CR, 42% MLM and 3% VO (CRMLM). Diet 3 consisted of 40% commercial feed mixed with 19.8% CR, 36.6% MOL and 3.6% VO. (CRMOL). Diet 4 consisted of 40% commercial feed, mixed with 18% CR, 19.5% MLM, 19.5% MOLand 3% VO (CRMIX). Each diet was fed to four replicate pens in a completely randomised design. CR, MLM, MOL and VO were added in such combinations to have similar crude protein and metabolisable energy contents as the commercial grower feed.

There were no significant ($P>0.05$) treatment effects on feed intake, but weight gain and final body weight were significantly higher ($P<0.05$) in the control group compared to the diluted diets. The best feed conversion ratio (FCR) ($P<0.05$) was recorded on the control group. Dressing percentage and breast muscle weight were not affected by dietary treatments ($P>0.05$), but drumstick weight was significantly higher ($P<0.05$) in the control compared to the other diets. The relative weights of the liver, proventriculus, and gizzard were not affected ($P>0.05$) by the diets. The relative weight of the small intestine was significantly reduced ($P<0.05$) on the control diet. There was no statistical difference ($P>0.05$) in small intestine weight among the diluted diets. The feed cost of meat production was numerically reduced on the CRMOL diet, but the differences were not significant ($P>0.05$). Saturated fatty acid content was similar among the diets ($P>0.05$), polyunsaturated and monounsaturated fatty acid contents were significantly higher ($P<0.05$) in the control and CRMIX diets. Because of the short duration of the trial, these findings may not be conclusive and there is a need for further investigations into the age of the birds and duration of the experiment.

Molecular and morphological analysis of elite cocoa trees (*Theobroma cacao* L.) on Makira Island, Solomon Islands

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More than six decades ago, cocoa (*Theobroma cacao*) genotypes Trinitario and Amelonado were imported into Solomon Islands as planting materials. This study collected cocoa leaf samples for molecular and morphological analysis from 40 genotypes in wards 10, 11, 8 and 7 on Makira Island in Makira Ulawa Province, Solomon Islands. DNA analysis of the cocoa accessions used 96 single nucleotide polymorphic (SNP) markers, selected from 1,560 candidates; SNPs developed from cDNA sequences from a wide range of cocoa organs based on the level of polymorphism and their distribution across the 10 chromosomes in cocoa. Genotyping found that 17 cocoa accessions show genetic heritage from Criollo, Parinari, Iquitos Mixed Calabacillo (IMC), Nanay and Nacional, ranging from 10.3 to 53.5%. The remainder of the accessions carried more than 90% of genes from Amelonado. Analysis of variance of the morphological characters showed significant differences ($p<0.05$) in pod external thickness, pod internal thickness and cotyledon length. Both genetics and morphology findings thus suggest that the cocoa population of Makira Island consists mainly of Amelonado type cocoa.

In vitro cultivation of Pacific *bele* (*Abelmoschus manihot* (L.) Medik.)

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This study optimised initiation protocol and explored different growing media for in vitro propagation of *bele, Abelmoschus manihot* (L.) Medik., an important leafy vegetable in the Pacific region. Varieties collected in Fiji were initiated using excised healthy lateral stems, consisting of shoot tips and nodes, and subsequently grown onto three growth media, namely: full strength Murashige and Skoog (MS), half strength MS, full strength MS with 0.3 naphthalene acetic acid (NAA), and half strength MS with plant preservative. Protocol for initiation of *bele* in tissue culture was established. Two in vitro experiments were conducted. The first one was the optimisation of media using four varieties, and in the second experiment, the sterilisation techniques were refined. Surviving plantlets were further screened in the screen house and then transplanted into the field.

The first experiment involved four *bele* varieties (*bele* 6, *bele* 7, *bele* 8 and *bele* 9). It demonstrated a survival rate of 26% for shoot explants and 32% for nodal explants. The second experiment was conducted with three varieties (*bele* 1, *bele* 6, and *bele* 8), yielding 80% survival for shoot explants and 27% for nodal explants. Significant differences were observed in experiment 2. Root length showed a significant difference, between *bele* 1 and *bele* 6 ($p = 0.013$), when cultured on ½ strength MS media.

For both in vitro culture and acclimatisation experiments, shoot explants on ½ strength MS media for experiment 2 performed best due to longer roots (plants with longer roots acclimatised well in the screen house). In the screen house acclimatisation phase, explants from both experiments showed similar survival rates (78% for experiment 1 and 75% for experiment 2). The growth responses of plants were analysed using SPSS software. Furthermore, explants from experiment 1 demonstrated 100% survival when transferred from the screen house to the field, highlighting the potential of this in vitro propagation technique for *bele*. Further experiments are going on to refine this in vitro technique which will provide the farmers with healthy *bele* planting materials.

Peanut seed treatments (PST) for organic peanut production systems in Vanuatu

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Peanuts (*Arachis hypogaea* L.) offer a potentially valuable option for growers in Vanuatu. The benefits of a clean 'organic' production system justify confidence in organic marketing opportunities to meet expanding demand both locally and overseas. A significant challenge in providing an organic peanut product is being able to establish the crop effectively without using conventional fungicides. Initial pot trial work was conducted in Australia to identify two organically certifiable seed treatment options for Vanuatu. These were Nutri-tech Bam and Nutri-tech Platform.

This paper outlines the pot trial work in which Nutri-tech Platform and Nutri-tech Platform + Bam were assessed for their effectiveness in terms of peanut seed germination with current locally grown Spanish and Runner varieties. Neither seed treatment product was found to be deleterious to peanut germination percentage. Peanut seed germination improved significantly with combined application of Platform + BAM seed treatment (98%), compared to the control (82%) and Platform treatment alone (87%). The trial also showed a significant difference in seed germination between the two varieties (samples), which needs to be further assessed to confirm the results and determine whether the difference between these varieties is associated with genetic differences or with seed production conditions. The positive effects of the seed treatments were also observed in the ensuing vegetative, flowering and fruiting stages.

Poster sessions

Impact of weed cutting on herbicide efficacy in Tonga

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Agriculture is the backbone of economy in Tonga and adopting organic herbicides could align with sustainable farming practices and reduce reliance on synthetic herbicides. Notably, herbicides account for approximately 70% of total pesticide usage in Tonga. Therefore, in our study, we compared the effectiveness of organic herbicides with glyphosate across two sites, one on the eastern side and the other located on the western side. A total of six treatments were applied to assess weed control: Treatment 1 involved cutting weeds without herbicide, Treatment 2 involved cutting and spraying after two weeks with organic herbicide, Treatment 3 involved cutting and spraying after four weeks, Treatment 4 applied organic herbicide without cutting, Treatment 5 had no cutting and spraying or control and Treatment 6 involved no cutting but spraying with glyphosate.

The results revealed that there were no significant differences between Treatment 1, Treatment 2 and Treatment 3 with organic herbicide applications compared to no treatment control. Treatment 4 and Treatment 5 did not display any significant differences either. Treatment 6, on the other hand, effectively suppressed weed growth with minimal regrowth. Overall, the findings show that cutting weeds did not significantly influence the effectiveness of herbicide application and glyphosate performed more effectively than the organic herbicides in controlling weed growth.

This study shows that while the organic based herbicide was not effective in suppressing weeds, the results can inform other options by testing additional treatments such as the inclusion of citric acid, sea water and a systemic organic herbicide to further assess their potential efficacy in weed management.

Analysis of underwater and waterways laws in Papua New Guinea

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Papua New Guinea in 2011 approved its first experimental deep-sea mining, the project situated in one of the Island provinces, New Ireland Province. The indigenous people protested against the operation of the mine on the basis that the country does not have any laws that provide for any mining activity in the ocean space or the inland waters. In 1997, along with 160 countries around the world, PNG ratified the United Nations Convention on the Law of Sea 1982. As a signatory country, the convention recognises the sovereignty of coastal states over fishing rights up to 12 nm (22.2 kilometres) from their coastline. They also have an exclusive economic zone that extends up to 200 nm (370 kilometres) from their coastline. However, PNG has not progressed in domesticating the convention in the country, the indigenous people and environmental defenders in the country protested and in 2019 the mine operation halted. The Constitutional and Law Reform Commission undertook the research on underwater and waterways laws in the country to establish the legal issue surrounding the mining activities in the ocean and inland waters. It was a two-year research project, during which the people of PNG were consulted and the views of the indigenous landowners in the coastal region were captured. The research identified the following issues: lack of policy and law on waterways and underwaters; the need for recognition of indigenous peoples' rights to ocean and inland waters; the need for PNG to create an administration or an authority to administer customary land in the country. The findings of the research recommended development of policies and laws to protect the indigenous landowners' rights and those of the government of PNG in terms of development of customary land.

Enhancing climate resilience in Pacific agriculture through integrated crop modelling and sustainable intensification: A case study on taro farming systems in Samoa

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The Pacific region, including Samoa, faces significant agricultural challenges due to climate change, land degradation, and limited access to modern farming technologies. Taro, a culturally and economically important crop, is particularly vulnerable to these environmental stresses. This presentation explores the transformative potential of integrating science, technology, and strategic partnerships to address these challenges.

We apply crop modeling to assess the potential of sustainable intensification (SI) interventions as climate change adaptation and mitigation strategies for taro farming systems in Samoa. By combining field data with advanced modeling tools, we aim to predict how various SI practices, such as agroforestry, optimised water management, and improved crop varieties, can enhance yield stability and resource efficiency under projected climate scenarios.

The results highlight how collaborative partnerships of local farmers, research institutions, and policymakers are critical to fostering resilient agricultural systems. We further demonstrate how data-driven decision-making can support policy development, enhance food security, and ensure sustainable land-use practices. This study provides insights into the broader implications of employing science and technology in agriculture and forestry across the Pacific region, positioning sustainable farming at the forefront of climate action through collaborative efforts.

Keywords: sustainable Intensification, crop modelling, climate change adaptation, taro farming, Samoa, Pacific agriculture

Assessing the regeneration of human generated mangrove systems in Fiji – Case study of Nasese and Lami foreshore

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The mangrove ecosystem is an essential part of the environment. There have been numerous planting initiatives from organisations and stakeholders in Fiji, yet there is lack of management and assessment to monitor and evaluate the succession of mangrove regeneration processes in a human generated system (mangrove ecosystem established through planting activities and initiatives).

The current study explains the unique deep linkage of the 'vanua' and the interconnectedness of the land and the Pacific people. A comparative study of Nasese and Lami was conducted to undertake sediment analysis, a monitoring and evaluation analysis of the two sites, to determine stakeholders' roles in mangrove management, monitoring and evaluation, and to further make recommendations for mangrove policies and management plans for Fiji.

Desktop research, sediment analysis, monitoring and evaluation visits, and key informant interviews with relevant stakeholders were employed for this study. Findings from the key informant interviews highlighted the need to assess available information in order to better guide developments that directly feed information to policy-makers for mangrove development advancement. This will promote local communities/resource owners to design, plan and execute mangrove-related projects and initiatives.

The study provided recommendations with regard to human generated mangrove systems: (i) to practise mangrove reforestation over mangrove afforestation; (ii) to conduct proper monitoring and evaluation on planting sites; (iii) to plan mangrove planting activities properly and scientifically support them before they are carried out to ensure high survival rates; and (iv) to actively involve resource owners or local communities so they take ownership of the maintenance, management and monitoring efforts for the longer term.

Scaling knowledge brokerage capabilities in the Pacific

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Pacific governments and communities are increasingly facing climate challenges, requiring them to integrate climate science and disaster risks into their decision-making. Knowledge brokers, especially Pacific knowledge brokers, help governments and communities source and integrate this information into their decisions and bridge connections across silos for a systems response to these complex challenges.

The Knowledge Broker Support Program (KBSP), funded by the Australia Pacific Climate Partnership between 2022 and 2023, aimed to build Pacific partners' knowledge brokering capacity. From its inception, the KBSP was focused on Pacific needs, co-creating and piloting content with decision-makers from Papua New Guinea and Solomon Islands. This ensured that materials were both relevant, practical and adaptable to specific Pacific contexts. A strategic

partnership with the Pacific Climate Change Centre (PCCC), hosted at SPREP, led to KBSP materials being integrated into existing Pacific capacity-building initiatives and sub-regional, national, and provincial-level workshops. Building on this work, the PCCC, with funding support from DFAT Australia, is developing a proposal for "Capacity building for knowledge brokerage for the Pacific private sector, women, youths, and vulnerable groups" to be presented at the PCCC Partners Dialogue on 13 March 2025 in Apia Samoa.

The KBSP is offered as an online Massive Open Online Course (MOOC) through Learn with Australian Centre for International Development ACFID, including a two-volume physical and e-manual, videos and case studies, presented by researchers and in-country partners, and made freely accessible on the PCCC's E-learning Platform, hosted on the Pacific Climate Change Portal, WeADAPT and CSIRO project website (https://research.csiro.au/pkb/). Additionally, CSIRO, the PCCC and the Australia Pacific Climate Alumni Network (APCAN) facilitated an in-person train-the-trainer course in Suva, Fiji, in April 2023 with participants from seven Pacific countries. Participants felt the training helped them better understand the climate adaptation knowledge and tools and how they can be used in a variety of contexts, identifying clear intervention points, addressing reoccurring organisational issues, and learning how to communicate the tools and processes with stakeholders.

Longitudinal evaluations revealed widespread adoption, with 90 KBSP-trained alumni subsequently training over 1,400 others. Evaluations confirm the KBSP's usefulness, noting its adaptability to various contexts and challenges. CSIRO fostered trust and collaboration, ensuring that complex scientific information was effectively translated and utilised by partners and stakeholders. PCCC is developing case studies to highlight lessons, best practices, and opportunities for broader application, ensuring further scaling and contributing to the programme's long-term sustainability, demonstrating KBSP's enduring value and quality.

Innovations and partnerships in Solomon Islands semi-subsistence agricultural practices

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Gardens sustain human life and human relationships. Gardens, or in Solomon Islands Pijin 'gaden', are heterogenous (e.g. what is grown, their significance to kinship connections, their size and location in relation to people's homes and villages). Moreover, gardening practices are themselves ways in which cultural practices are sustained and enacted. What then happens when communities are introduced to innovations in their work practices and approaches to gardening?

This paper describes the introduction of two innovations in two Solomon Islands field-sites: crop rotation, and FAITH gardens (i.e. Food Always In The Home). In both field sites, these were not practised before being introduced in the project. The innovations were introduced as part of a research project that aimed to trial and adapt a family-based programme, the Family Farm Team (FFT) programme, in Solomon Islands. The research has been undertaken over the past five years (see ACIAR website).

The FFT programme is a family-based programme that includes women and men. Workshops are followed by peer-to-peer, or farmer-to-farmer learning, to encourage participants to share their knowledge, skills and understanding with their families and community (see Hill, Basi and Rahe 2022; Hill and Pamphilon 2024). The programme includes activities in areas such as communication, planning, and healthy food and nutrition. The programme is delivered in conjunction with relevant agricultural and livelihood training. It was implemented by Live & Learn, Solomon Islands, while agricultural training was delivered by Kastom Gaden Association.

The paper focuses on the roles of partner organisations and community groups in the implementation of the research project. We present findings from the project, with a focus on the two agricultural innovations, highlighting the role of partnerships between researchers, implementing NGOs, community organisations and family groups in its success. We argue that, while the research project design paid attention to social and cultural embeddedness, it was the practices of the implementing partners that proved crucial to its success. While gardening innovations have been introduced, gardens continue to sustain human life and maintain human relationships.

Influence of agroforestry species on the growth and yield of kava in an intensively cultivated farm of Tutu, Fiji

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Kava production in Fiji increased from 3871 tons in 2014 to 13790 tons in 2021 (MOA 2021). The increase in production is mainly due to an increase in kava prices after cyclone Winston which activated 17228 farmers to cultivate kava. With the rise in the number of farmers growing kava, more pressure is placed on limited land resources. More marginal land is being used for kava farming in the northern part of Fiji. Deforestation in these farms is at its peak and is the main threat to biodiversity loss in Fiji (O' Breien et al. 2021). Poor growth and yield are evident after one or two cycles of the crop due to loss of shade and nutrient depletion that needs urgent attention. A well-designed agroforestry system has the potential to minimise deforestation and improve the soil fertility of the existing farms.

A field study was conducted at Tutu Training Center in Taveuni, Fiji to evaluate the ability of Erythrina, Calliandra, Gliricidia, and previously deforested fields on the survival rate, kava growth parameters, and yield in a previously cultivated field. Agroforestry trees were pruned twice a year. The total N and P pool size in the pruned tree material was about three times higher for Erythrina pruning than for Calliandra and Gliricidia pruning. The number of kava plants that survived and reached the second year of cultivation under the Erythrina, Calliandra, Gliricidia, and previously deforested fields were 94%, 98%, 89%, and 18% respectively

Mitigating the impacts of climate change on coconut plantations through the use of Mucuna cover crop

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Climate change will affect coconut plantations due to higher temperatures, variation in precipitation levels, adverse natural phenomenon such as cyclones, increased incidence of weeds, pests and diseases, and increased vulnerability of organic carbon pools. Unlike in seasonal crops, climate change effects will be long-standing in coconuts, since they are a perennial crop. The occurrence and severity of cyclones and droughts are predicted to increase with climate change. Field surveys after TC Winston (2016) and TC Yasa in (2020) concluded that coconut plantations could lose 10–40% of trees, depending on their intensity and path. The palms that survived TC Winton took almost three years to fully recover. A siz-month drought period in 2018 resulted in a 48% decline in coconut production in Fiji.

Various approaches can be used to mitigate risks associated with seasonal climate variability, including the introduction of cover crops and the adoption of appropriate management practices. The use of mucuna cover crop in coconut plantations, especially during droughts, has been shown to increase female flower initiation by 29% and increase coconut yields by 61%, compared to plantations with traditional weed cover. This study confirmed that the mucuna cover crop had significantly higher (p>0.05) biomass production and accumulated higher levels of N, P, K and Ca in its foliage than traditional weed cover. It also significantly (p< 0.05) suppressed more weeds than traditional weed cover.

The impact of volcanic activity on the agriculture sector in the Kingdom of Tonga

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The agriculture sector forms the foundation of the economy of the Kingdom of Tonga, comprising between 16% and 30% of GDP. For this reason, soil condition, and plant and animal health are critical factors for the economy. Despite being on coral-dominated bedrock, the soils of the main inhabited islands of Tonga are andisols – formed from weathering of a regular input of volcanic ash. The Kingdom of Tonga, located in the southwest Pacific, forms part of the Pacific Rim of Fire, which is characterised by frequent periods of volcanic activity.

The Tofua Volcanic Arc – a >600 km-long chain of subaerial and submarine volcanoes – lies to the west of the inhabited Tongan islands and is responsible for regular volcanic ash contributions. Ongoing surveys have so far shown that over the last 6500 years, over 35 large magnitude explosive eruptions have occurred along the Tofua arc, with each main island group receiving ash fall on at least 12 to 15 occasions, the most recent being in January 2022.

Despite low-level winds being dominantly south-easterly, large eruptions eject ash to >3 and >>30 km (e.g. in 2022) which means most volcanic ash clouds travel eastwards, under the influence of the upper tropospheric winds. Ashfall on inhabited Tongan islands in 2022 caused widespread crop losses, major damage on stormwater/drainage, damage to electricity infrastructure, and animal health issues, mediated later by the natural addition of soil nutrients from the new ash. The 2022 impact was based on only 1–3 cm of ashfall. By contrast, our surveys of past events indicate falls 5–30 cm thick can be expected. In the case of falls >10 cm, we could expect total agriculture loss with recovery periods of nine to12 months. This paper will provide an update on the frequency and magnitude of volcanic ash-producing eruptions, compiling data collected over the last 25 years in conjunction with the Tongan Geological Services. We will review potential scenarios based on the composition, grainsize and thickness of ashfall.

Taro pits of Kayangel atoll, Palau: characteristics, challenges and management strategies

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Giant swamp taro (*Cyrtosperma merkusii)* holds significant cultural and nutritional value on the atolls and mountainous islands in Micronesia. Production has, however, declined in atoll regions, and there is an urgent need to identify and address the underlying causes of this decline. Soil sampling from giant swamp taro fields in Kayangel atoll, Palau, reveals that taro pits have elevated sodium (Na^+) levels. High sodium concentrations, derived from increased groundwater salinity in taro pits, adversely impact soil structure, permeability, and fertility, posing significant challenges for taro cultivation. All the porewater samples had very low sulfide concentrations, suggesting that the decline in taro crop production is not caused by elevated sulfide concentrations. This article examines the features, causes and management strategies in Kayangel's taro pits, aiming to support sustainable agricultural practices in these fragile ecosystems.

Assessment and analysis of the availability and nutritional quality of local and regional resources to support the Pacific aquaculture sectors

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Aquaculture is essential in the blue economy and can generate high-quality farmed seafoods that improve food security and socio-economic conditions in the South Pacific. The region has a huge potential, benefiting from large pristine marine habitats, strong fisheries and wide species diversity. But it also faces many challenges, such as geographical distances, lack of seeds and feeds, limited domestic markets and climate change. Best opportunities to date have resided in high value species that are typically extractive and unfed, while farmed fish and crustacean production has been limited.

The development of the blue shrimp aquaculture sector in New Caledonia is an example of socio-economic success and, while high quality feeds are made on the island, they are dependent on the importation of raw materials, such as fishmeal and soybean meal. CSIRO, Australia, has partnered with IFREMER and SICA based in New Caledonia to transform the circularity and sustainability of aquaculture feeds. Our project aims to identify more regional sources of plant, animal and microbial raw materials and by-products for the manufacture of feed for animal production, with a focus on shrimp aquafeed formulations. We are conducting nutritional analyses, in vitro and in vivo digestibility and growth studies, comparing the use of current resources to more regional, circular and sustainably sourced ones. Preliminary results will be presented with a vision to understand commonality and potential to integrate other South Pacific Island resources. With this ongoing project, we will investigate the resilience of the aquaculture sector, challenges and opportunities for growth in the South Pacific, the role of aquaculture in the broader food system, and its relevance to enhancing the circular bioeconomy.

Integrating culture, conservation, and innovation: Tutu Rural Training Centre's breadfruit farming success story

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This paper tells the success story of Tutu Rural Training Centre's (TRTC) breadfruit farming efforts, focusing on how culture, conservation and innovation were brought together to improve farming practices. The main goal of the work was to combine traditional knowledge with new ideas to make

breadfruit farming more productive, sustainable and helpful for local communities. The study involved hands-on training with farmers, using simple tools and methods to improve breadfruit quality and harvesting. Farmers learned about pruning, harvesting at the right time, and planting better breadfruit varieties. These activities were supported by regional partnerships, including the Pacific Breadfruit Project, which helped share knowledge and develop new ways to farm breadfruit more effectively.

Key results show that proper pruning and harvesting methods made it easier to collect fruits and improved the quality and shelf life of breadfruit. Training programmes also helped farmers adopt better practices, and TRTC became a leading example of how traditional knowledge and modern farming techniques can work together. The work at TRTC demonstrates how connecting culture, conservation, and innovation can help breadfruit farming thrive, while also providing a model for sustainable farming in the Pacific region.

Farmer-led Innovation in breadfruit value chains: Lessons from Tonga

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This paper highlights how farmers in Tonga, with support from Nishi Trading Ltd and the Core Innovation Group, are leading the way in improving breadfruit farming and value chains. The focus is on using simple tools and techniques to make breadfruit farming more efficient, improve fruit quality, and reduce waste, while keeping local practices and needs at the centre. The project worked closely with farmers to teach them better ways to grow, harvest and prune breadfruit trees.

Workshops held at Nishi Trading Farm introduced new tools and showed farmers how to use them. Farmers also learned how pruning can make harvesting easier and improve tree health. These hands-on sessions helped farmers see the benefits of small changes in their farming practices. Results showed that these innovations improved breadfruit quality and shelf life, making the fruits better for local and international markets. The collaboration of farmers, Nishi Trading Ltd, and regional research partners ensured that solutions were practical and worked well in Tonga's conditions. This success story from Tonga shows how farmer-led innovation, supported by training and partnerships, can strengthen breadfruit farming and value chains.

Localised innovation in agroforestry: Building farmer capacities in the Western Province of the Solomon Islands

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This paper explores how localised innovation in agroforestry is helping farmers in the Western Province of Solomon Islands improve their livelihoods. Led by the Kastom Gaden Association, in partnership with Luesalo Rural Training Centre (LRTC), the project focuses on building farmers' capacity with the integration of traditional knowledge and modern agroforestry practices, using the Improved Temotu traditional agriculture (ITTA) system as a foundation. The work involved hands-on training and field activities aimed at designing and implementing modified ITTA agroforestry systems that balance competition for water, nutrients, and sunlight, while enhancing the productivity of breadfruit and other crops. Farmers learned to identify superior breadfruit varieties, propagate planting materials, and practise sustainable tree management techniques.

Key outcomes include the successful revitalisation of an improved agroforestry model, using an existing agroforestry set-up at LRTC and increased farmer knowledge of breadfruit propagation and care, and the expansion of breadfruit collections through planting and tree improvement activities. Collaboration with LRTC ensured that local farmers received practical, culturally relevant training tailored to their needs.

This initiative highlights the importance of combining traditional agroforestry systems with innovative practices to strengthen food security and build resilient farming systems. The lessons from the Western Province demonstrate the value of farmer-led innovation, regional collaboration, and culturally grounded approaches in creating sustainable agricultural solutions for Pacific countries.

Fostering women-led innovation in breadfruit: Climate-smart practices and economic diversification in Papua New Guinea

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This paper highlights the role of women-led innovation in breadfruit farming in Papua New Guinea, focusing on climate-smart practices and economic diversification. Through the efforts of the Papua New Guinea Women in Agriculture Development Foundation (PNGWiADF), women farmers are at the forefront of improving breadfruit production, reducing climate risks, and creating new income opportunities for their communities. The initiative engaged women farmers in training programmes that emphasised sustainable farming techniques, including pruning, harvesting, and integrating breadfruit into agroforestry systems. Women learned how to identify climate-resilient breadfruit varieties and adopt methods that improve fruit quality, shelf life, and marketability. The programme also supported women in exploring value-added products, such as breadfruit flour and chips, to diversify income streams.

Through the Pacific Breadfruit Project (FORI), PNGWIADF is working towards improving breadfruit yields, greater resilience to climate variability, and enhanced economic empowerment for women farmers. Local partnerships with the National Agriculture Research Institute of PNG provided valuable support, sharing tools, knowledge, and market insights to ensure the sustainability of these efforts. By focusing on women's leadership, the initiative is not only advancing breadfruit farming, but is also fostering gender equality and strengthening community resilience.

This case study demonstrates how women's innovation and leadership can drive climate-smart agriculture and economic diversification, offering valuable lessons for empowering women and enhancing food security in the Pacific region.

Optimising land productivity: Intercropping breadfruit with cash crops in Cook Islands

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This paper examines the efforts of Te Tango Enua in Cook Islands to optimise land productivity through intercropping breadfruit with cash crops, while addressing the challenges of declining breadfruit production. By combining traditional agricultural practices with innovative techniques, the initiative aims to improve food security, diversify income sources, and restore breadfruit as a vital crop in Cook Islands.

Breadfruit production in Cook Islands has declined in recent years due to factors such as aging breadfruit trees, reduced planting, and changing agricultural priorities. Recognising the importance of breadfruit for food security and cultural heritage, replanting efforts have been launched through the Pacific Breadfruit FORI Project. These efforts focus on propagating superior breadfruit varieties, promoting sustainable farming practices, and revitalising breadfruit orchards across the islands. The project also introduced intercropping systems that integrate breadfruit trees with high-value cash crops, such as taro and vegetables. Practical training sessions helped farmers learn how to design and manage these systems, focusing on planting density, crop compatibility, and sustainable land use. Lessons from regional partners, including the FORI Project, provided valuable insights into breadfruit tree management and agroforestry best practices.

The project is actively working towards achieving key outcomes, such as increased crop yields, improved breadfruit quality, and higher income for farmers. The integration of cash crops with breadfruit not only enhances land productivity but also reduces the risk of crop failure and improves soil fertility. Replanting efforts have rejuvenated interest in breadfruit cultivation. This work highlights the value of combining local knowledge with localised farmer-led research to address the decline of breadfruit, optimise land productivity, and support resilient, diversified farming systems.

Farmer-led agricultural research in the Pacific Islands: Advancing innovation through the Pacific Breadfruit Project

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This paper explores the role of farmer-led agricultural research in advancing innovation through the Pacific Breadfruit Project (FORI) in five Pacific Island countries: Tonga, Cook Islands, Fiji, Papua New Guinea, and Solomon Islands. The FORI project aims to enhance breadfruit production and value chains by combining traditional knowledge with modern agroecological practices, focusing on sustainable farming, food security, and economic development.

The project objectives include identifying and propagating superior breadfruit varieties, promoting farmer-led innovation, and developing agroforestry systems that optimise land use while addressing environmental challenges. Hands-on training and workshops have been central to the project, empowering farmers with skills such as pruning, harvesting, and integrating breadfruit into diversified farming systems. Activities such as phenotypic characterisation of breadfruit varieties, the introduction of climate-resilient farming practices, and the creation of new value-added products have further supported the project's goals.

Key achievements that the Pacific Breadfruit Project (FORI) is working towards include the establishment of improved agroforestry models, strengthened farmer networks, and enhanced breadfruit quality and shelf life. Regional partnerships have been instrumental in sharing resources, knowledge, and tools to ensure the sustainability of these efforts. The project's emphasis on farmer-led action research has fostered innovation, resilience, and the adoption of practices tailored to the unique conditions of each country.

This case study highlights the transformative potential of farmer-led agricultural research in addressing regional challenges. By combining local knowledge, regional collaboration, and practical innovation, the Pacific Breadfruit Project provides a replicable model for strengthening breadfruit value chains and advancing sustainable agriculture in the Pacific Islands.

The contribution of farmer organisations to agricultural development in Pacific Islands

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Farmer organisations have become key drivers of agricultural development in Pacific Islands after more than two decades of public sector support. This study examines their impact and reaches across 14 Pacific Island countries and territories (PICTs) through a cost-benefit analysis of major publicly funded agricultural development programmes, including those supported by the European Union, the International Fund for Agricultural Development, and the Australian Department of Foreign Affairs and Trade. The research draws on extensive farmer surveys to track shifts in sources of agricultural advice, planting materials, and innovation over the past two decades, highlighting the influence of increasingly dynamic value chains in the region.

Findings underscore the critical role of farmer organisations in preserving traditional knowledge while operating in a culturally appropriate and inclusive manner. Additionally, the study highlights the comparative advantage of farmer-led research in the Pacific context and the essential role of farmer organisations in driving innovation and addressing complex agricultural challenges in partnership with the public sector. These insights provide valuable guidance for policymakers, development agencies, and stakeholders seeking to enhance sustainable agricultural growth in the region

Developing regional transdisciplinary partnerships for Pacific atoll food security

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Atolls are especially vulnerable to rising sea levels, saltwater intrusion, and extreme weather, which threaten their food systems. The impact of COVID-19 and international conflicts has increased food costs and disrupted supply chains. Transport difficulties drive reliance on processed foods, causing food insecurity and higher rates of non-communicable diseases. Environmental degradation, pests, and resource depletion have long-lasting impacts on both land and marine ecosystems, affecting the resilience of atoll communities. Limited resources and siloed projects hinder alignment.

Addressing systemic challenges unlocks scalability and synergy. To tackle these challenges, *Direction de l'Agriculture de Polynésie française* (DAG), in partnership with the Ministry of Environment, Lands and Agricultural Development (MELAD) Kiribati, and CSIRO Australia, co-developed shared research priorities. These priorities guided the development of a collaborative KIWA grant proposal. The proposal functioned as a boundary object to develop relationships, identify knowledge-sharing opportunities to act on research priorities, and begin a regional partnership. Starting in October 2023 at the PROTEGE regional workshop on food systems in French Polynesia, the three teams shared their challenges, opportunities and visions for the future. Over 18 months, the teams co-developed a proposal on nature-based solutions for atoll environments to offer a locally led approach to enhancing food production and ecosystem co-benefits in ways that are fit-for-purpose and sustainable.

Key insights include: (i) in-person visits that enabled relationship building, developing in-depth understanding of local systems; (ii) strategic alignment with existing country projects and policies that eased the demand on organisations with limited time and resources; (iii) Identifying areas of complementarity or strengths of each partner; and (iv) shared knowledge gaps that shaped the design of the partnership. The co-development process has: (i) facilitated exchanges to visit and learn from food systems in each country; (ii) opened discussions on a theory of change for the partnership; (iii) created a greater understanding of atoll challenges and opportunities; and (iv) strengthened relationships, enabling more effective collaboration in the future.

Soil judging competition as a new tool to elevate soil and land evaluation skills in the Pacific region

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Soil judging competitions provide a fun, competitive way to engage participants in a format that stands apart from other methods of learning in soil science. Participants spend two days developing essential skills required for describing soils and evaluating land-use capability, primarily through hands-on learning in the field, supplemented by focused presentations from local experts. On the third day, participants put their new knowledge to the test in a competition, where they describe a new soil profile, and produce an associated land capability evaluation. Their results are then compared and graded against the reference results from experts.

Skills in soil description, classification and land-use interpretation are urgently needed in New Zealand, Australia, and across the Pacific region to address the challenges of protecting soil resources, adapting to and mitigating the effects of climate change, and land-use planning. The soil judging competition format is unique and provides a way to bring students and working professionals together, regardless of their country of provenance or experience.

Additional benefits include gaining exposure to different soil types and land uses, as competitors travel well beyond their local region. Here, we reflect on the success of the Moana Oceania Soil Judging Competition that was held prior to the Soils Rotorua conference in New Zealand, December 2024. The event brought together over 200 individuals from across the Pacific region, making up 16 teams from New Zealand, 16 teams from Australia, and three teams from the South Pacific. It is our understanding that this event was the largest of its kind ever organised worldwide. The success of the event required setting up an organisation committee of soil scientists from New Zealand, Australia, and the Pacific region, operating under the Organisation Committee of the conference, and the New Zealand Society of Soil Science. The hard work of the Soil Judging Competition Committee represents more than a year and a half of careful planning. We make the case that soil judging competitions offer a unique, competitive format that serves as an effective tool for science diplomacy, promoting engagement and peer-to-peer collaboration among soil and land scientists across the wider Pacific region.

Plant biosecurity partnerships in the Pacific region

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Plant protection and plant biosecurity are of paramount importance in the Pacific Islands, given their unique ecological makeup and reliance on agriculture for sustenance and economy. Invasive pests, pathogens and weeds, however, pose significant threats to native flora and agricultural productivity. Effective plant protection and biosecurity measures are essential for safeguarding these fragile ecosystems and ensuring food security for local communities. Fostering collaboration of governments, scientists, and farmers, the Pacific Islands can mitigate the risks posed by invasive species, preserving their natural heritage and sustaining livelihoods.

EUPHRESCO III supported a workshop to better understand the plant health/biosecurity research needs and priorities for Pacific Island communities and territories in August 2024 in Auckland, New Zealand, alongside the New Zealand Plant Protection annual science meeting.
Early, mid, and late career attendees (students, scientists, lecturers, regulators, managers from the Pacific Islands (ca. 15) and Australia/New Zealand (ca. 30) were represented.
During the workshop, the attendees considered aspects of strategy, priority crops, priority organisms (pest, pathogens and weeds), priority science, capacity and capability, and the promotion of partnerships in relation to invasive species and plant biosecurity and protection. Workshop priorities were compared and contrasted in the context of current Pacific Islands strategies. The views of attendees, from the Pacific Islands in particular, were highlighted. A report detailing the results of the workshop is available from the author.

Beef24: Using existing industry events to engage with Pacific-based research partners

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Beef cattle is an important industry across all Pacific Island countries, including Timor Leste. While small by global standards, these beef cattle industries make important contributions to household income and livelihoods, custom ceremonies and community nutrition, employment and gross domestic product. All countries want to develop and grow their beef industries within the context of an increasingly variable climate, emerging biosecurity risks, increasing costs of production and policy-related challenges around land tenure, access to infrastructure, aging workforce and urbanisation, and declining research and extension expertise.

A Pacific region beef event (Beef24) was organised to expose key representatives of the Australian Centre for International Agricultural Research (ACIAR)'s international research partners to: (i) innovation, practices, policy and markets in the Australian beef industry; (ii) to provide a model to foster interaction between ACIARs international partners and public and private sector stakeholders in the Australian beef industry; and (iii) to hold a Pacific region beef workshop to identify and prioritise regional research and capacity-building issues that may contribute to sustainable and productive Pacific beef industries.

Delegates (13) from six countries (Fiji, Papua New Guinea, Solomon Islands, Timor Leste, Tonga and Vanuatu) attended a triennial beef industry event, Beef Australia, in Rockhampton, Australia over three consecutive years. Delegates participated in seminars and facilitated meetings and property tours with time allocated to independently engage with other participants and exhibitors. Delegates also participated in a Pacific region beef workshop, with beef industry updates provided by all countries. Opportunities for research, capacity-building and industry development were identified by each country and ranked by all participants to identify priority researchable issues and capacity-building requirements across the region. Post-event feedback was collected from participants, sponsors and organisers via an electronic survey. The feedback was overwhelmingly positive from all respondents. Suggestions on improving this experience were collated and included allocating additional time to the Beef24 venue, opportunities for co-funding, inclusion of master classes and attendance at more seminars, with a range of practical suggestions also made to improve logistics of facilitating such an event.

It is recommended that similar models be used to engage research partners and expose them to innovation and new concepts for inclusion in their own strategic and research planning, industry development and policy decisions in the future. The concept of a Pacific Beef Network was supported and the capacity-building and research issues identified could form the basis for establishing such a network.

Enhancing sweet potato production in atoll environments: Evaluating food cubes and organic fertilisers for sustainable agriculture

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Agricultural production in the Pacific region has been in decline for decades, exacerbating food insecurity and malnutrition. Limited access to fresh, nutritious produce has contributed to high rates of non-communicable diseases and dental health issues. Atoll communities are particularly vulnerable, as they rely heavily on imported food shipments, which can be disrupted by extreme weather events. Additionally, poor soil quality and saltwater intrusion in gardens further constrain local food production. Food cubes have been developed as an innovative solution to mitigate these challenges by preventing saltwater intrusion, optimising water use, and utilising composted materials to enhance crop growth.

This study evaluated the yield performance of sweet potato *(Ipomoea batatas)* grown in food cubes under different organic fertiliser treatments. A comparison was also made between planting in food cubes and raised beds directly on the soil. Results indicated that the application of 2.5 t/ha poultry manure significantly ($p < 0.05$) increased sweet potato yield (40.1 t/ha) compared to the control (17.6 t/ha), with a yield gain of 22.4 t/ha. However, there was no significant difference in yield between plants grown in food cubes and those cultivated directly in the soil. These findings suggest that food cubes can serve as a viable alternative for crop production in land-constrained environments, provided adequate organic inputs, such as poultry manure, are applied at recommended rates.

Evaluation of Abrus precatorius as a potential toxicant for baiting in the management of the invasive white-footed ants, *Technomyrmex* spp., in Fiji

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The Technomyrmex white-footed ant (WFA), recognised as an invasive alien species (IAS) in the Pacific Islands, has become a significant pest in Fiji, affecting homes, gardens, and urban areas. Effective and sustainable management strategies for WFAs are virtually non-existent. Recent studies suggest that plants may serve as sources for nature-based solutions to agricultural challenges, including IAS management.

This study evaluated the potential of Abrus precatorius, a weedy herbaceous plant, as an organic bait toxicant for managing WFA infestations in Fiji. A series of no-choice (toxicity) and choice (repellency) tests were conducted to evaluate the repellency and toxicity of Abrus precatorius. Results indicated that 0.5% w/v water extracts of Abrus precatorius seeds exhibited greater toxicity to WFAs than leaf extracts, although the difference was not statistically significant. Comparisons with Mortein® spray and 10% borax w/v in icing sugar, showed no significant differences in mortality, but Abrus precatorius seed extracts performed relatively effectively. Repellency tests revealed that the 0.5% w/v seed extract solution was comparable to 25% sucrose solution, demonstrating low repellency. This combination of low repellency and toxicity highlights the potential of Abrus precatorius as an organic bait toxicant.

The findings suggest an environmentally sustainable approach for controlling this invasive ant species, offering an alternative to synthetic pesticides and reducing associated human health risks.

Farmers' perception of climate change and its impacts on farm produce in Sigatoka, Labasa, and Taveuni areas of Fiji

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Globally, climate change poses significant threats to agriculture, and small island nations such as the Pacific Islands, are particularly vulnerable due to their reliance on rainfed agriculture. This study explores how smallholders in the Sigatoka, Labasa, and Taveuni areas perceive the impacts of climate change on agricultural productivity and the strategies they employ for adaptation.

The study aims to identify farmers' knowledge, perceptions, and awareness of climate change and its effects on agricultural production. A mixed-methods approach was used to collect data from 90 farmers using structured surveys and semi-structured interviews. SPSS was used to analyse quantitative data, while NVivo was used to extract qualitative insights to provide a comprehensive understanding of farmers' knowledge, attitudes and practices.

The findings indicate that socio-economic factors, particularly levels of education and income, play a significant role in shaping farmers' awareness of climate change effects. Despite widespread concern, over 90% of participants expressing varying degrees of apprehension regarding climate change, a significant gap persists between awareness and the implementation of adaptive strategies. While many farmers acknowledge the critical importance of adaptation to ensure agricultural resilience, fewer than half have undertaken proactive measures, primarily due to resource constraints and a lack of practical training. The study further identified key areas where farmers perceive climate change as negatively affecting agricultural productivity, including reduced crop yields and soil degradation driven

by erratic weather patterns. Furthermore, it highlights adaptation strategies employed by farmers, such as agroforestry and crop rotation, while emphasising the pressing need for targeted educational initiatives that address local challenges and opportunities. By exploring the nexus between farmers' lived experiences and scientific understanding, this research contributes to the broader discourse on agricultural adaptation to climate change. It advocates for integrated policy frameworks designed to empower farmers and enhance resilience in the face of changing climatic challenges.

Bridging circular economy and resilient agriculture: organic matter for fertile soils

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In New Caledonia, dependency on imported fertilisers represents a major economic and environmental challenge. This project aims to promote resilient agriculture by valorising locally sourced organic matter derived from recycling streams. The project seeks to develop technical, economic, and environmental benchmarks for using local organic fertilisers to enhance soil fertility and replace imported mineral fertilisers, particularly in maize cultivation, a significant consumer of such inputs. Experimental field trials, conducted in partnership with Adecal Technopole, compared different fertilisation methods: (i) standard mineral fertilisation; (ii) Imported organic fertilisation; and (iii) four locally produced organic products derived from recycled waste: (a) co-compost of green waste and wastewater sludge; (b) fishmeal derived from offshore fishing by-products processed through cooking and drying; (c) dried wastewater sludge; and (d) co-compost enriched with fishmeal.

The trials allow for the evaluation of yield, crop uniformity, and the profitability of the practices. While the preliminary results do not show significant gains with local organic fertilisation, the environmental benefits are already evident, as the products come from recycling streams. Early observations suggest slightly improved crop uniformity, with yield components comparable to mineral fertilisation. These results need to be confirmed over time, as the benefits of organic fertilisation are primarily realised in the long term, particularly in terms of soil fertility and the resilience of production systems.

Key partnerships drive this initiative. Valorga coordinates stakeholders, supports product characterisation, and creates synergies between recyclers and users. Adecal Technopole contributes technical expertise for trial implementation. The initial results from the experimental trials conducted with Adecal Technopole validate the effectiveness of these practices, thus facilitating their transfer to farmers.

This experimental project is a key step before broader implementation. A new project, led by the Chamber of Agriculture and Fisheries and Valorga, with technical support from Adecal Technopole, will be carried out in 2025–2026 to expand these trials with producers, assess the long-term effects on crop production, profitability and soil fertility, and promote the adoption of organic fertilisers. This project demonstrates the synergy between science, technology, and partnerships to transform agricultural practices sustainably. By integrating local organic products into production systems, it contributes to reducing reliance on imported inputs, recycling waste, and strengthening agricultural resilience in the Pacific region.

Nutritional evaluation of new sweet potato cultivars of French Polynesia

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In the context of developing and promoting subsistence crops for food security, sweet potatoes cultivars have been crossbred and selected to improve yield, pest tolerance and nutritious factors. Sweet potatoes are known to be healthy foods rich in nutrients, especially pro-vitamin A such as β-carotene. The purpose of this work was to evaluate the amount of certain nutrients in these new hybrids and to observe the effect of cooking on their bioavailability. For this purpose, thirteen cultivars with flesh colour ranging from white, yellow, orange to purple were subjected to extraction, and several analyses were performed on both raw and cooked extracts, such as the quantification of total carotenoid content, total anthocyanin content, total polyphenol content and antioxidant assay. The results suggest that the flesh colour of sweet potatoes is an indication of their nutritional composition. Moreover, cooking has a positive effect on nutrient availability, as cooked sweet potatoes contain higher levels of carotenoids, anthocyanins, polyphenols and antioxidants. Finally, the cooked sweet potato with the darkest purple colour had the best results for all parameters and seems to be the best candidate in terms of nutritional benefits. These results need to be confirmed by replicating the experiment, and alternative cooking methods could be tested and compared to the results of this study.

Monitoring pesticide residues in local vegetables in French Polynesia

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The regulation of maximum residue limits (MRLs) for pesticides was updated in French Polynesia in 2021, resulting in lower MRLs. Our annual programme to monitor pesticide residues in local fruits and vegetables revealed exceedance of MRLs, particularly in Chinese cabbage. Some non-recommended pesticides for this crop were also detected. Unlike in other countries, local regulations do not specify usage by active substance. However, not all pesticides are suitable for all crops, and factors such as crop cycle duration, crop characteristics (leafy vegetables, tubers and fruits), and pesticide mode of action must be considered. Therefore, a study was conducted to monitor the degradation of several insecticides and fungicides on test plots of Chinese cabbage. The objectives were to determine the degradation time of each active substance in Chinese cabbage plants, estimate a preharvest interval (PHI) for each active substance relative to local MRLs, check for potential synergistic effects on degradation kinetics and provide recommendations on preferred active substances for Chinese cabbage cultivation in French Polynesia.

In two trials, conducted in 2022 and 2023, Chinese cabbage plants were transplanted in the field and treatments with 16 insecticides and two fungicides were applied. Samples were collected every two to three days and prepared, using the European QuEChERS method for analysis with multi-residue methods, using GC-MS/MS and LC-MS/MS. The results showed that residues of some pesticides were in trace amounts whilst others decreased to reach local MRLs and some remained above MRLs throughout the period of the experiment. The study determined PHIs for most active substances without ambiguity, whilst PHIs for chlorfenapyr, fipronil and lufenuron were estimated due to residues exceeding local MRLs at the end of the experiment.

Recommended active substances include deltamethrin, chlorantraniliprole, spinosad, L-cyhalothrin, difenoconazole and esfenvalerate. Substances not recommended due to their initial use, PHI and European bans include lufenuron, chlorfenapyr, fipronil, permethrin, dimethoate, bifenthrin and imidacloprid. Producers have been informed of the PHIs and recommended active substances for Chinese cabbage cultivation in French Polynesia.

Consumers' perception and willingness to consume goat milk and milk products in Viti Levu, Fiji

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Livestock play an important role in ensuring food security and alleviating poverty (Wodajo *et al.* 2020). They are important sources of cash income and employment for producers and others working in the value chain and providing, milk, meat, manure, skin and hide. The contribution of goat milk to the economic and nutritional wellbeing of humanity is undeniable in many developing countries. Goat milk plays a very important role in health and nutrition of young and elderly and is also known for its beneficial and therapeutic effects on people who are allergic to cow milk.

This research aimed to understand consumers' attitudes and willingness to consume goat milk and milk products in Fiji. It was conducted in two stages. The first stage involved interviews with 100 goat producers to gather information on their socio-economic characteristics, farming practices, challenges, and the viability of the goat milk industry. The majority of farmers were male (82%), with primary school education (48%) and no prior training in goat farming (89%). Most farmers focused on meat production (95%), and subsistence farming was predominant (63%). The second stage involved interviews with 100 consumers to understand their attitudes towards consuming goat milk and goat milk products. The findings revealed that butter was the most consumed dairy product (100%), while goat milk had been consumed by 24% of respondents, with varying consumption rates in the Western and Central Divisions. A significant portion of respondents (72%) expressed their willingness to consume goat milk and goat milk products, with female respondents (73%) and Indo Fijians (95%) showing the most interest. The study also stressed that consumers prioritise halal certification, affordability, consistent supply, and local production when purchasing dairy goat products. However, the lack of local availability remains a significant barrier to consumption in the study area.

Using eggs of *Bactrocera tryoni* (Diptera: Tephritidae) as food for the rearing of coccinellids

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Aphids are significant pests of many crops worldwide, not only as sap suckers but also as virus vectors. In French Polynesia, they are abundant on vegetables (cucumber, cabbage), taro, banana, citrus, and ornamental plants. Mass-rearing and release of ladybugs in crops is a natural control solution against these pests. A rearing of the aphidophagous ladybug *Harmonia octomaculata* was established in Tahiti. Ladybugs are voracious and, in mass rearing, they are rarely fed aphids but rather frozen butterfly eggs (mainly eggs of the flour moth *Ephestia kuehniella*). These eggs are produced in factories and sold frozen. They must be imported and kept frozen during transport, making them very expensive. To reduce the production costs of ladybugs in Polynesia, experiments were conducted to evaluate the suitability of fruit fly eggs (*Bactrocera tryoni*), routinely reared in the laboratory, to feed ladybugs. The survival, fecundity, and offspring viability of adult ladybugs fed *E. kuehniella* eggs or *B. tryoni* eggs were studied. Adult ladybugs fed on *B. tryoni* eggs were able to survive and to produce viable eggs, but the number of eggs laid was less than those of the ladybugs fed on *E. kuehniella* eggs.

Liveweight gain response of yearling heifers to the availability of drinking water in Vanuatu

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Farmers in the Pacific face the challenge of maintaining or increasing productivity in an increasingly variable climate. Climate-adaptive management practices will be required to secure the future of these farming businesses. In Vanuatu, this climate variability includes an increased frequency of below average annual rainfall years. Cattle farmers in Vanuatu often identify a lack of drinking water for cattle as a major constraint to production. Very few smallholders provide drinking water to cattle on their farms in Vanuatu. One of the reasons for this is the lack of information on the response of cattle to drinking water through normal annual cycles, from which they can make informed decisions on investment in water infrastructure to deliver water to cattle grazing in paddocks.

An experiment was conducted at the Vanuatu Agricultural Research and Technical Centre, Vanuatu. In each of three years (2019, 2023, 2024) new cohorts of yearling heifers (n = 14, 250 kg liveweight) were blocked on breed (Charolais or 'Local'), ranked on liveweight and randomly allocated to one of two treatments (drinking water [n = 7] v no drinking water [n = 7]). Each group of heifers was placed in adjacent 2.5 hectare paddocks containing *Megathyrsus maximus* pasture, with a water trough and artificial shade in each paddock. The heifers were rotated between the two paddocks every 28 days. The water trough was turned on in the paddock that contained heifers allocated to the drinking water treatment, whilst the water trough was turned off and securely covered for heifers allocated to the no drinking water treatment. Heifers were weighed every 28 days and pasture samples were collected for biomass availability and dry matter (DM) content.

Liveweight gain of heifers with drinking water available had higher liveweight gain than heifers without access to drinking water (0.4 v 0.3 kg/day; $P < 0.05$) in 2019 and 2023 but there was no significant difference in liveweight gain in 2024. There was no difference in liveweight gain between Charolais and Local cattle. The biomass of available pasture was typically above 2000 kg DM/hectare with the available pasture containing approximately 300 g DM/kg. At the stocking rates used in the current experiment, this equated to an additional 100 kg additional liveweight produced per hectare per year. The data generated provides important information from which calculations on long-term return on investment in water delivery systems for cattle be made by cattle farmers in Vanuatu.

Decoding the community food security landscape

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Food security in island communities is particularly vulnerable to climate disruption and health-related disasters due to socio-economic-ecological (SEE) constraints and limited adaptive resources. The conventional resilience-based framework assumes that communities can absorb disruptions and return to normalcy. However, for marginalised populations, "normal" often means a pre-existing state of food insecurity, making this framework inadequate.

This research proposes to shift towards restoration and transformation of the food system by integrating indigenous knowledge with scientific methods to enhance food sovereignty and adaptive capacity. The study explores food system vulnerabilities, adaptations and recovery mechanisms in two different island communities – Hawai'i and Fiji. Hawai'i is heavily dependent on food imports – currently about 90% of the food is imported. Government policies have systematically eradicated traditional agricultural practices, replacing self-sustaining indigenous food systems with a dependency on external food sources. In contrast, Fiji has maintained strong subsistence agriculture and traditional food practices that enhance food sovereignty, despite economic and environmental challenges.

By comparing these two communities' food systems, we aim to discover the role of traditional foodways in fostering food security. The research has three main goals: (i) re-weaving urban food environments in Hawai'i and Fiji to evaluate accessibility, distribution, and adaptability; (ii) remembering traditional food knowledge through communities' experiences; and (iii) re-rooting policy recommendations to integrate traditional food systems into contemporary urban planning and governance. Our research combines spatial and statistical analysis with qualitative insights from community engagement. By mapping food networks, analysing policies, and examining lived experiences, the study aims to uncover systemic barriers and solutions for culturally relevant interventions.

Adoption of short messaging service (SMS) for seasonal farm advisory services in PNG to inform policy and practice

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Papua New Guinea (PNG), one of the most vulnerable countries to climate change, aims to provide improved early warning information to 70% of the total population to respond to climate extremes. SMS is extensively used in PNG in the agriculture sector to convey information to influence practice change but there is limited understanding of the utility of using SMS in the agriculture sector in the management of climate change.

This research explores the possibility of adopting SMS to disseminate seasonal farm advisories in PNG and the policies and practices necessary to optimise its adoption. As a practical investigation, PNG National Weather Service (NWS) and PNG National Agriculture Research Institute (NARI) co-created seasonal farm advisories based on the seasonal forecast of the whole Eastern Highlands Province and used SMS to disseminate them to 81 farmers and extension officers twice a week for two months.

This research utilises a mixed-method approach, including a pilot study for developing and disseminating SMS-based farm advisories and conducting user surveys to explore user intention about adopting SMS. The collected survey responses were analysed with the UTAUT framework – user acceptance and use of technology – to measure users' intention to use SMS.

The results of this study indicate that SMS-based seasonal farm advisories production in PNG is highly demanded by SMS users. The study also highlights the need for user-tailored advisories, effective advisory co-creation workflows, extension support, participatory engagement approaches, affordable mobile devices, efficient networks, and proper maintenance of the SMS platform to translate user intention into adoption. This knowledge base will inform national or international bilateral and non-government agencies working in climate services in PNG to plan future investment priorities and avoid duplication of time and resources. The platform and working model developed as part of a pilot will be an asset for PNG partners to scale up their climate services to new geographic locations or new sectors, such as coffee, agroforestry and food crops in PNG.

Genetic characterisation and control strategies of *Ralstonia solanacearum* (Bacterial wilt) in French Polynesia

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Ralstonia solanacearum is responsible for bacterial wilt on Solanaceous crops such as tomatoes, peppers, eggplants and potatoes. In French Polynesia, this disease significantly affects agricultural production in Tahiti (tomatoes) and Tubuai (potatoes). Farmers have experimented with various approaches, including resistant tomato varieties and soilless cultivation methods. The introduction of tomato yellow leaf curl virus (TYLC) in Tahiti in 2014 makes tomato production more challenging, with new varieties resistant to both pathogens. Several plant host species were sampled and bacterial strains were isolated and characterised. The molecular typing of bacterial samples from Tubuai and Tahiti revealed contrasting epidemiological situations. In Tubuai, all bacterial strains belong to phylotype I sequevar 18. In Tahiti, strains are primarily phylotype IIB sequevar 4 (96 isolates), with some phylotype I-18 strains (7 isolates). Phylotype IIB4, identified in Tahiti, is known to persist in soils for several years. Results also suggest that phylotype I strain in French Polynesia has an Asian origin.

Yield gap analysis of taro in Samoa using decision support system for agrotechnology transfer (DSSAT) model

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Taro (*Colocasia esculenta*) is crucial to Samoa's culture, economy and food security, yet its yields often fall short of potential. This study aims to quantify the yield gap of taro using the DSSAT model, with data collected from taro farms in wetland and dryland sites between 2023 and 2024. Key variables, such as soil properties, climate, crop management, and yield data, were used to calibrate the model, which then simulated taro growth under optimal conditions to estimate potential yields. The model was then employed to estimate potential yields under optimal conditions and compare them with actual yields to quantify the yield gap.

The study revealed significant yield gaps between the actual and potential yields of taro in both sites in Samoa. In dryland sites, the yield gap was 86.17%, whilst in wetland sites the yield gap was 97.88%. To address this yield gap, alternative management scenarios were developed that had the potential to improve taro yields. This included variations in the management of nitrogen fertiliser, planting windows, planting density, the addition of irrigation, and a combination of these scenarios. The management scenarios tested show a significant improvement in yield compared to the baseline. The combination of management scenarios, including shifting planting from baseline (January) to October, applying a nitrogen fertiliser rate of 500 kg/ha, using a 1 m x 1 m spacing with four plants per square metre at a depth of 30 cm, and providing 15 mm irrigation, has significantly narrowed the yield gap between the predicted and potential yields. In the dryland scenario, the gap was minimised from 86.17% to 1.29%, whilst for the wetland scenario, the gap was minimised from 78.85% to 3.66%. This suggests that adopting these specific management practices can close the yield gap significantly and bring yields closer to their potential, especially in less favourable dryland environments.

Effects of desalinated water and rainwater on the yield and yield parameters of Chinese cabbage (*Brassica rapa* subsp. *chinensis*) in Nauru

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Water scarcity and the lack of fertile soil in Nauru make agriculture production challenging. Under the Pacific Organic Learning Farmers Network (POLFN) project, farmers were provided with support to produce mulching material and to grow crops using organic composting methods. While this supported crop production through the provision of soil medium, the farmers were still challenged with the effect of desalinated water on plant growth.

At the request of the farmers, this research was carried out to compare the growth of Chinese cabbage (Brassica rapa subsp. chinensis) under desalinated water and rainwater in Nauru. The experiment was conducted in one of the lead farmers' fields and at the government's research station. The experiment was laid out in a 2x2 factorial experimental design with four treatments replicated four times. The main factors considered were raised bed versus non-raised bed and rainwater versus desalinated water. The addition of raised bed and non-raised bed was made at the request of the farmers, as these are the two most common practices of growing vegetables in Nauru.

The results showed that the Chinese cabbage grown under raised bed and watered with desalinated water produced more leaves and had a higher plant growth rate than the other treatments. The fresh yield was also significantly higher ($p \leq 0.05$) compared to the non-raised bed and rainwater treatment. Overall, the results indicated that the growth of plants watered with desalinated water was comparatively better than those plants that were watered with rainwater. Furthermore, the nutritional content of the plants that received desalinated water was higher than that of the rainwater treatments, with carbohydrate levels for the raised bed and desalinated water significantly higher ($P \leq 0.05$) than the raised bed and rainwater treatment. As desalinated water is costly, the authors recommend the use of desalinated water under a drip irrigation system to help save costs.

Challenges in assessing economic impact of marine recreation tourism. Tongan case study of visiting cruise ships, yacht visitors and the whale watch industry

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Tonga tourism is trying hard to recover to the pre-Covid level of tourism arrivals and activities in the Kingdom. Then came the unprecedented submarine volcanic eruption in Hunga Tonga Hunga in Ha'apai islands near Nuku'alofa, with the associated tsunami in mid-January 2022. This once in a lifetime natural disaster destroyed, inter alia, almost half of the tourism accommodation and economic activities in the main island of Tongatapu and the surrounding offshore islands. This left a huge gap in the effort to fast-track tourism arrivals and activities.

Tonga marine recreational activities have been the mainstay of recent tourism attractions, namely the sub-sectors visiting cruise ships, yacht visitors and the well-known whale watch industry.

The purpose of this presentation is to discuss some challenges, and update reports on current research surveys as part of the Tonga Tourism Satellite Account effort to assess the status and economic benefits from these three main tourism sub-sectors. The findings will shed some light on challenges and opportunities that may help policy makers and stakeholders in their

recovery programme and in the further development of these main tourism activities in Tonga. Recommendations and findings from this ongoing research may be duplicated in similar destinations in the region.

How does agricultural knowledge flow? An analysis of social networks in the Pacific

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The aim of this poster is to present a way of testing a methodology that offers a semi-quantified analysis of knowledge systems with a theoretical framework based on Stone's general theory of agricultural knowledge production. Although farmers' environmental and social learning methods have been extensively documented, there remains a significant gap in our understanding of didactic learning (i.e. knowledge gained from non-farmers) and the interactions among all three learning modalities.

The methodology combines social network analysis (SNA) with an agricultural knowledge and innovation system (AKIS) framework. Data collection was facilitated using tablets and the MySurveySolution tool. During data processing, each network was categorised according to Stone's general theory nomenclature. In all, 50 individual interviews were conducted with farmers in New Caledonia and Wallis and Futuna, and from this a comprehensive and accurate visual representation of the sources and circulation of agricultural knowledge and biological materials was reconstructed.

The resulting SNA maps illustrate the following: (i) yam uses and knowledge on Maré Island in New Caledonia; (ii) agroforestry practices and knowledge on the West Coast of New Caledonia; and (iii) vegetable cultivation and market dynamics in Wallis and Futuna. Beyond their scientific relevance, SNA graphs, or 'maps', serve as visual tools that can anchor and facilitate discussions on complex concepts and Pacific realities, particularly the social dimensions of agriculture. Ultimately, this graphical visualisation of knowledge and material flows is an efficient and cost-effective tool for measuring the interactions, or lack thereof, between public policy, civil society, and subsistence/professional farmers in agricultural knowledge production.

Knowledge, perception and practice of antibiotic use among livestock farmers in the Central Division of Fiji

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This mixed-methods study aimed to: (i) characterise veterinary antimicrobial imports into Fiji over a 12 month period; and (ii) evaluate the knowledge, perception and practice of antibiotic use and antimicrobial resistance (AMR) among livestock farmers in the Central Division of Fiji.

Out of 15 antibiotic import shipments during November 2016 to October 2017, just under half (40%) were initiated by non-government veterinarians, with the broad-spectrum antibiotics amoxicillin and cephalosporin being imported most frequently. Seven per cent of antibiotic imports were initiated by individual (non-veterinary) users. Semi-structured interviews with 10 livestock farmers from Fiji's Central Division found that, despite the widespread use of antibiotics with livestock, farmers were not aware of AMR or its risk to public and animal health.

Educational barriers and social norms may discourage farmers from questioning veterinary personnel about antibiotic administering practices. Veterinarian-delivered education and awareness campaigns may be considered to help improve veterinary-farmer AMR communications and assist Fijian livestock farmers to optimise antibiotic usage.

Linking food grown and nutrition between aiga and togalaau (home and garden) in Samoa

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A preliminary study was undertaken where research questions focused on the constraints and opportunities of supporting home food production in the garden to ensure healthy nutrition pathways in homes in Samoa. Seven case study families were interviewed about their gardens and gardening practices, home food environments and food practices.

Household-garden interviews identified the desire to grow and access nutritious and healthy food for family members as a key motivation to garden, especially where households had young children, elderly or non-communicable diseases present. Traditional and non-traditional crops were of interest to gardeners. Growing crops such as tomato and leafy brassicas were newer to households but held high interest. Soil quality at case study sites was good, but opportunities for crop management to enable better production were evident. Soils could benefit from additional nitrogen and potassium and in some cases, phosphorus and sulphur, to sustain or improve yields. Sources of this need to be local to be affordable and may require revisiting practices such as composting, manuring, mulching, restorative crops and fallowing. Households with little or no garden were keen to grow their own food, but they cited resource and time challenges as barriers. Further barriers included the aging population and lack of youthful workers for home

gardens due to either lack of youth interest or unavailability (e.g. commitments to seasonal worker programmes).

Home interviews and food diary analysis indicated families were eating recommended serves of fruit (2.0 serves/day) and vegetables (5.1 servings/day), with a tendency towards starchy vegetables (3.3 serves/day). This leaves room for greater incorporation of leafy vegetables in family's diets. In general, energy, sugar and salt intakes were very high and could be reduced in diets. Encouraging greater reliance and intakes from Pacific gardens would help to reduce these high intakes.

Kalapu-tō-vanila: Vava'u farmers growing their knowledge of vanilla production in Tonga

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How does an agricultural programme best engage with smallholders? How do you find a way to embrace the knowledge that exists within farmers and enhance that with new or gap-filling knowledge in a respectful and empowering way? Peer-to-peer or farmer-to-farmer learning groups show strong potential to help farmers grow their learning. Tonga Vanilla was a four or five year project based in Vava'u, Tonga, and focused on lifting vanilla quality and quantity, considering climate change and farm management opportunities and risks.

A farmer-to-farmer vanilla grower approach was used across 12 village-based groups known as *Kalapu-tō-vanila* (KtV). Roughly translated as 'Vanilla Club' KtVs provided farmers with a familiar concept as *Kalapu-tō-kava*/Kava Clubs already existed locally. The programme teamed local vanilla extension expertise (including MAFF), PFR's science expertise, and local farmer knowledge within the KtV to help facilitate farmer learning. Benefits of this approach included: (i) empowering of learnt 'hands-on' farmer knowledge and skills; (ii) embracing of different ages and genders; (iii) farmers learning directly from other farmers – a process that aids trust and adoption of new practices; (iv) visiting different plantations to see issues first-hand and compare practices; (v) recognising farmer experience of and within that locality; (vi) enhancing social connections for farmers; (vii) helping to inform gap-finding or new knowledge development; (viii) opportunities to share different ways of doing activities, such as pollinating; (ix) farmers being able to challenge new information from a place of collective strength; and (x) enabling local extension staff to also upskill alongside farmers.

The KtV also had challenges to work through to achieve effective extension. The process does require having a minimum of five or six farmers in attendance to enable good discussion. Meeting dates could be disrupted by other community events, such as funerals, and would need rescheduling. Further, farmers were busy and had many commitments, so KtVs had to prove their usefulness at every meeting. Good facilitation was found to be important within KtVs to encourage the farmers to speak up and vocalise their thoughts, practices and experiences.

A farmer field school approach to support improvement of cattle farms in the Big Bay area of Vanuatu

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Farmers in the Big Bay area on the island of Espiritu Santo, Vanuatu, are geographically isolated from markets, input suppliers, and extension and support services, with poor access to transportation and communication infrastructure. The Australian Centre for International Agricultural Research funded *Bisnis Blong Buluk* project implemented a business planning and farmer field school (FAO) approach to support small cattle farmers in Vanuatu to develop and implement plans to increase productivity, profitability and environmental sustainability of their cattle farms. It was hypothesised that a farmer field school approach would provide farmers in Big Bay with the knowledge, skills and experience to make informed decisions on how to improve their cattle farming business.

The project established and completed two Buluk Farmer Field Schools in Big Bay over a period of 12 months. The Farmer Field Schools involved 8 and 12 households respectively, with each school approximately six months in duration. Each school involved a problem definition and prioritisation lesson, which identified one or two researchable issues to be tested and a series of special topics to be presented by thematic specialist. The prioritisation lesson was followed by five facilitated lessons with the research trial established and monitored, and special topics delivered. The research topics included documenting the movement of cattle from Big Bay to the nearest market pickup point, the establishment of forage peanut (*Arachis pintoi*) under kava plants, strategies to control hibiscus burr (Urena lobata) and the establishment of introduced grass species under coconut trees. The special topics delivered included marketing, bank loan access and understanding terms and conditions, biosecurity, animal health, castration, small livestock, stockyard designs, industry (value addition), farm budgeting, weaning and time management. Participant evaluations were completed at the end of each lesson and at the end of the entire field school.

The Farmer Field School approach provided farmers in this area with access to information and skills not previously provided by traditional support services. The households have used the information and research findings to register their businesses, access loans, upgrade farm infrastructure to improve herd management (stockyards, fencing), control priority weeds and establish new businesses. Integration of cattle farming business plans with a farmer field school was a successful model for information exchange and skills development of cattle farmers in remote areas of Vanuatu and created a road map for medium-term improvement of cattle farms in Big Bay.

Optimisation of different substrates for mass production of *Metarhizium* sp. for the management of the coconut rhinoceros beetle, *Oryctes rhinoceros*, in Samoa under laboratory conditions

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The Coconut Rhinoceros Beetle (CRB), Oryctes rhinoceros, has been a major insect pest of coconuts in Samoa since its introduction in 1909. This insect pest damages palms, affecting agricultural productivity. One of the effective approaches to control CRB is the application of the green muscardine fungus (GMF), *Metarhizium* sp., a biological control agent against this pest. GMF's mass production and delivery systems are critical to obtaining the optimum effect of the fungus.

To improve field dissemination of GMF, this study explored suitable substrates for mass production under Samoan conditions. This study aims to identify suitable substrates for GMF production. The use of taro, breadfruit, rice, and various mixtures of these materials were tested under laboratory conditions. The GMF strain used in this study was isolated from an infected CRB larvae cadaver collected from one of the hot spots in Upolu. Pathogenicity tests confirmed that the isolate caused disease in CRB larvae. Results indicated that substrate choice significantly influenced the yield and quality of fungal conidia biomass, yield and quality. This study provided crucial information in applying GMF efficiently and effectively in the field. Consequently, it will influence the development of integrated insect pest management against CRB utilising biological pest control strategies to revitalise Samoa's coconut industry.

Brassica pest management in Fiji: Farmers' perceptions and practices

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Worldwide, the adoption of sustainable pest management practices, such integrated pest management (IPM), is compromised by the reliance of farmers on broad spectrum pesticides. Strategies and available technologies for the deployment of IPM against brassica pests are well developed but adoption rates remain low.

In this study we focused on brassica pest management in Fiji in an effort to better understand the perceptions, motivations and practices of farmers. Fifty farmers in the Nabitu, Nabaka, and Siminilaya settlements, a major brassica production area in the Sigatoka valley, were interviewed in October 2022. Interviews were followed up in 2024 with a series of nine focus group discussions (FGDs) (mean number of participants = 8/FGD) that included farmers from other brassica farming communities from the two main islands of Viti Levu and Vanua Levu. Adoption of IPM was extremely rare and all farmers interviewed rely on synthetic insecticides to manage insect pests.

Key constraints to the adoption of IPM were the perceived unreliability of cultural control measures and lack of awareness of the benefits of natural enemies. The reliance on synthetic insecticides is such that farmers apply insecticides between one or two times per week, often mixing products and increasing recommended doses. Based on conservative estimates of the level of inappropriate insecticides use, it was estimated that a typical brassica crop will receive 39 label rate applications of insecticide in a 12-week growing period.

Brassica pest management in Fiji: Predicting farmers' behaviour

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Sustained rates of integrated pest management (IPM) adoption by farmers are typically low. Although specific constraints can be identified under certain circumstances, no existing model

consistently predicts adoption. To address this, this study developed and evaluated a conceptual model of the adoption process, with a derived framework that unifies decision-making, adoption and behaviour as a continuous learning process. The model was empirically evaluated in the context of brassica pest management in Fiji, with specific focus on four key components of an IPM approach: (i) crop rotation; (ii) natural enemies of pests; (iii) *Bacillus thuringiensis* insecticide; and (iv) rotation of insecticides as part of an insecticide resistance management (IRM) strategy.

A total of 122 farmers were interviewed and 10 focus group discussions (FGDs) were conducted in major production areas in five provinces of Fiji (Nadroga and Naitasiri on Viti Levu and Bua, Macuata and Cakaudrove in Vanua Levu). In the FGDs, farmers responded to a series of [If, then] decision-making scenarios. The model accurately predicted farmers' behavioural responses (P=0.04) and proved to be a better predictor of outcomes than considering awareness, validation or attitude alone. FGDs provided supporting evidence that awareness, validation, and attitude themselves, or together, can act as driver(s) or barrier(s) to farmers' behavioural responses. This improved understanding of constraints to IPM adoption can be used to develop targeted responses for extension to improve adoption.

Screening the largest taro collection worldwide for viruses for food security

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Genebanks play a pivotal role in the conservation and use of priceless genetic resources for adaptation to climatic changes. CePaCT (Centre for Pacific Crops and Trees, Suva, Fiji) is the only regional genebank for the Pacific region and conserves more than 2100 accessions of 18 crop species (including the largest taro collection worldwide), as well as seeds of tree species of great relevance for the region. CePaCT's activities supporting the development of climate-resilient food production systems include: (i) *in vitro* screen house and field evaluation of diversity for resilience and yield traits; (ii) selection of resilient diversity; (iii) incorporation of these new materials into breeding programmes undertaken collaboratively with members and partners to generate new potentially resilient diversity; and (iv) distribution of clean seedlings to farmers across the Pacific region.

To enable the distribution of clean material, each taro accession was screened for known taro viruses* using PCR at three critical times** and high-throughput sequencing discovered several other viruses infecting taro***. This will help safeguard and keep disease-free all crop varieties already available and positively affect the consumption of diverse and nutritious domestic food that will guarantee healthy diets and sustainable livelihoods for Pacific communities. *- Taro Bacilliform Virus, Taro Reovirus, Cucumber Mosaic Virus, Dasheen Mosaic Virus (and other Potyviruses using universal primers), Taro Vein Chlorotic Virus, Colocasia Bobone Disease Virus ** - at 3, 6, and 9 months after planting. *** - TBA

Food loss along the value chain of taro: a look at postharvest handling practices of taro and climatic hazards in Samoa and Tonga

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The food loss and waste crisis represent a complex and multifaceted global issue that has had far-reaching effects on the global economy, social welfare, and environmental sustainability. This study looks at food loss along the taro value chain, with a focus on postharvest handling procedures in Upolu, Samoa and Tongatapu, Tonga. The objective of the study is to gain a better understanding of these procedures and identify strategies for reducing food loss, improving economic outcomes, and promoting better nutrition for households involved in the taro value chain. The study also compares and contrasts the postharvest handling practices and losses between the two locations to gain insights into the similarities and differences in taro farming practices in Samoa and Tonga.

Data for this study were collected through fieldwork, including interviews with farmers, sample collections, and laboratory analysis. A total of 80 farmers were surveyed with a few farmers shadowed from harvest to point of sale. The study findings contribute to knowledge on how to reduce food loss and waste in the taro value chain and promote sustainable agriculture practices in Samoa and Tonga. By answering these research questions, we hope to gain a better understanding of the postharvest handling procedures of taro in Samoa and Tonga and identify strategies for reducing food loss and improving the economic and nutritional outcomes for households involved in the taro value chain. Also, by comparing the postharvest handling practices and losses between the two locations, the study contributed to a better understanding of the similarities and differences in taro farming practices in Samoa and Tonga.

Harnessing coconut by-products for social and environmental impact: A sustainable business model and community-driven value chain approach

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The Pacific region faces major challenges in achieving agricultural sustainability, handling waste management and enhancing economic resilience in rural communities. Coconut farming remains a key economic activity, but large volumes of coconut byproducts – such as husks and shells – are often discarded, leading to environmental degradation, pest and health issues, and lost economic opportunities.

This research examines how science, technology and partnerships can transform coconut waste into high-value products, whilst fostering community-driven business models that enhance rural livelihoods. The study explores a decentralised, community-owned micro-franchise value chain model, in which communities use clean technology – including energy-efficient processing and solar-powered mini-grids – to convert coconut byproducts into soil amendment and regeneration products. This model has an inclusive, scalable framework for sustainable economic development that integrates circular economy principles.

The research employs a mixed-methods approach, combining desktop research, field trials, stakeholder workshops and socioeconomic analysis. Key metrics include financial viability, employment generation, carbon footprint reduction and sequestration, and adoption of sustainable practices.

Current findings indicate that community-owned enterprises reinvesting profits into shared infrastructure can accelerate the adoption of sustainable agriculture, whilst reducing reliance on external subsidies. Moreover, integrating the productive use of renewable energy improves processing efficiency, lowers costs and attracts investment. We are validating the concept of scaling localised value-added processing with private sector stakeholders and exploring how partnerships with research institutions and government agencies can speed up the process. This research demonstrates the added value of inter-regional research and the ability of cross-sector collaboration to drive widespread adoption of innovative business models. The early-stage pilot programme shows strong interest from processors to support their farming communities. Ongoing research explores policy incentives and financing mechanisms to support large-scale deployment of decentralised processing models, ensuring long-term economic resilience for rural and coastal communities.

Integration of sustainable agricultural intensification practices to taro-based cropping systems for climate-resilient agriculture in Pacific Island countries

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Climate change is expected to increase extreme rainfall events in Samoa, leading to increased weed growth and herbicide use, which in turn will further degrade soil health in taro farming systems. In search of a solution, this study investigated sustainable agricultural intensification (SAI) practices in the taro (*Colocasia esculenta*) farming system at the experimental site of the University of the South Pacific campus in Samoa. The treatments included alley cropping (taro only or with one of these leguminous alley crops: Erythrina, Gliricidia, or Sesbania) and weed control methods (hand weeding, sheep grazing + hand weeding and mulching + spraying). Data were collected during the cropping season (August 2023 to May 2024) to evaluate the effects of these treatments on taro production.

Amongst the weed control treatments, mulching + spraying resulted, on average, in higher mean fresh corm yield, compared to sheep grazing + hand weeding or the hand weeding control. Mulching + spraying ($p<0.001$) and sheep grazing + hand weeding ($p=0.002$) both produced higher fresh shoot yields than hand weeding alone, with statistically significant differences.

Amongst the alley crop treatments, sole taro produced the highest mean fresh taro corm yield, followed by Gliricidia, Erythrina, and Sesbania. Taro plots with Gliricidia alley cropping had the highest mean fresh taro shoot yield, followed by sole taro, Sesbania, and Erythrina. Overall, alley cropping did not affect ($p>0.05$) taro corm or shoot yield, compared to sole taro.

The first-year results indicate that mulching + spraying is the most effective weed control strategy, compared to hand weeding, enhancing both below- and above-ground crop production. Sheep grazing + hand weeding may offer additional income by integrating livestock into the cropping system. Alley cropping showed potential, as it did not reduce taro yield due to crop competition and provided mulching materials to the crop. This demonstrates that alley crops are compatible with taro-based systems, helping maximise productivity.

More SAI experiments will be conducted at the same site in 2025 and 2026 to expand these findings and explore the long-term effects of SAI practices on soil health, productivity, and the environmental health and resilience of taro farming systems.

A SWOT analysis and review of the freshwater prawn aquaculture industry of Fiji

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In Fiji, the natural stocks of freshwater prawn (*Macrobrachium lar*) are being depleted and the rate of growth of freshwater prawn (*Macrobrachium rosenbergii*) aquaculture has shown little progress, at times remaining stagnant and even showing signs of decline. Fiji has a 50-year history of freshwater prawn aquaculture and it cannot meet the demand for freshwater prawn locally. Informed decision-making at all levels is needed for the growth of the industry.

This study aims to determine the status, challenges and potential for growth of the industry. It undertakes a PEEST (policy, economic, environmental, social and technical) review to add depth to a SWOT (strength, weaknesses, opportunities and threats) analysis, of which its outcomes will determine possible strategies that will contribute to the growth of the industry.

Fiji has put forth a four-year national Aquaculture Development Plan with a vision of boosting production of cultured species, including freshwater prawn (*Macrobrachium rosenbergii*), with strategies such as public private partnership and the establishment of a training centre for its officers.

The main issue found in the PEEST review and SWOT analysis is the need for a constant supply of PLs (post larvae). The root cause for the lack of PL supply being the lack of funding for Fiji's MOF (Ministry of Fisheries) aquaculture related activities, the ministry has been supplying PLs free of charge since it was first introduced as a potential species for aquaculture. Smallholder freshwater prawn farmers are not able to survive on the inconsistency of PL supply, leading to a very low number of freshwater prawn farms. Fiji's aquaculture industry needs to get to a stage where it can thrive with little reliance on the government, and the aquaculture development plan is a step in the right direction. We argue that, despite the range of influences, political influence has been the main contributing factor to the industry's past and current statuses.

Experiences on the coconut rhinoceros beetle, *Oryctes rhinoceros*, management efforts in Vanuatu

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The coconut rhinoceros beetle (CRB), *Orytes rhinoceros,* is a destructive invasive plant pest causing damage particularly to coconut palms, oil palms and other ornamental palms in the Indo-Pacific regions. CRB invaded Vanuatu in 2019 and has caused significant damage to the coconut palms and ornamental palms since then. Its symptoms were first confirmed on the island of Efate in May 2019 and recently in May 2024 on the island of Santo. In trying to contain the spread and

suppress the population of CRB in the country, a combination of mechanisms and integrated pest management is being implemented with funding support from the New Zealand Ministry of Foreign Affairs and Trade and technical support from the Pacific Community, Landcare Research , and AgResearch in New Zealand.

The integrated pest management efforts to combat the spread of CRB over the years include legislative measures, innovative programmes such as the Beetle for Cash Program, community engagement initiatives, biocontrol agents uses, pheromone trappings, sanitations, awareness programmes and government support. There are signs of the biocontrol agents spreading and promising signs of palms recovering around the island of Efate but management efforts will continue until such time as the beetle is well contained on the Islands of Efate and Santo. All the other islands throughout Vanuatu are still free of the pest.

This presentation will be about the management efforts of CRB in Vanuatu and will emphasise the importance of collaborative approaches in combating CRB and other agricultural pests.

High throughput sequencing of vanilla ecosystems supports viral disease management in Tonga

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Vanilla is an economically significant crop in Tonga, susceptible to various viruses. Before our study, the most recent research of viruses in vanilla Tonga was in the 1990s, based on visual symptoms and enzyme-linked immunosorbent assay (ELISA) tests. In our study, despite observing typical viral-like symptoms on vanilla plants, there was poor correlation of viral-like symptoms and the detection of the previously reported viruses by the Tonga and New Zealand-based laboratories using targeted ELISA and end-point reverse transcription polymerase chain reaction (RT-PCR) methods. To understand the reason(s) for the poor correlations, we used high throughput sequencing (HTS) to screen symptomatic and non-symptomatic vanilla plants from multiple plantations across the island groups where vanilla is cultivated. HTS was also used to screen neighbouring non-vanilla species from multiple plantations on the island of Vava'u, to understand the virome within vanilla plantations and to inform disease management protocols.

The HTS data revealed at least five different viral species in vanilla, which included viruses known to infect vanilla in Tonga, such as the dasheen mosaic virus (DsMV), and first reports of other virus species infecting vanilla in Tonga and internationally. Notably, previous known viruses were typically genetically different from other genotypes reported to date (e.g. DsMV genotypes identified in our HTS screen only had >80% nucleotide sequence similarity with reported sequences). The genetic differences and new viruses identified provide insights into the potential reasons for our initial failed attempts to detect viral casual agents from plants with viral-like disease symptoms. In addition, viruses found in vanilla were also identified in the non-vanilla plant species, which included surrounding ground cover plans, the vanilla support tree and intercrops such as taro.

We will demonstrate how the results have been used to improve disease management protocols for farmers in Tonga, and to develop new diagnostic tools that reliably detect key viruses. We will also highlight the wider implications of our results for other Pacific Islands, and how our HTS-based ecosystem approach could be used for other Pacific Island ecosystems.

Women's role and economic analysis of small-scale fish farming in Serua and Namosi Provinces in Fiji

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Small-scale fish farming could become highly important as a sustainable livelihood approach, especially for rural communities in many developing countries such as Fiji. This study explored women's roles and the economic viability of small-scale tilapia farming in Fiji's Serua and Namosi provinces. The research addressed knowledge gaps regarding women's contributions and profitability, providing insights for rural development and gender equality promotion.

The research utilised a mixed methods approach that incorporated surveys and interviews at 43 farms, with active/inactive farmers, male/female household members, provincial council representatives, fisheries officers, and non-tilapia farmers in the two provinces. Key topics examined the roles of women and a SWOT analysis of strengths, weaknesses, opportunities, and threats, alongside the financial outcomes of fish farming. Data analysis included descriptive statistics, profitability measures, and thematic coding.

The results revealed that women contributed significantly to pond maintenance, feeding, harvesting, and marketing, but their average income was modest, at 15.75%. Cultural norms and limited resources hindered their decision-making participation. Economic assessments showed a 30x20 m pond in Serua yielded a net profit of FJD 4,925 with an 87.6% margin, while a smaller 20x10 m pond earned FJD 1,420 at 61.9%. Larger ponds in Namosi were more profitable, with a 30x20 m pond netting FJD 4,047.70 at a 74.8% margin. The findings demonstrated the viability of small-scale tilapia farming in rural areas, although challenges like high input costs and environmental vulnerability exist. Future prospects may benefit from expanding local markets and improving technical support.

These findings suggest that fish farming enhances household food security and provides income but women's roles are often overlooked, indicating a need for initiatives that empower them and address cultural barriers.

In summary, small-scale fish farming is a viable option for sustainable rural development. To maximise its potential, gender-inclusive policies and better access to training and financial resources are essential.

Evaluating the effectiveness of animal health care workers in Fiji and Samoa

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Livestock diseases result in poor productivity, such as low milk yield, poor weight gain, and high mortality rates, affecting farmers' daily income and food security. To counter these serious problems, veterinarians are needed to diagnose and treat diseases, thereby preventing the spread or incursion of endemic and exotic diseases on farms. Their main role is to ensure food safety and public health.

There is a lack, however, of qualified veterinarians in the Pacific region. Community-based animal health care workers (CBAHW) and para-veterinarians are officers who have been had training in basic veterinary practices. Their primary purpose is to increase livestock productivity in the

local communities by providing essential, affordable animal health care services that are easily accessible to livestock farmers. However, due to the lack of animal health care workers and the challenges faced in delivering their services, the provision of animal health care may not satisfy the demand from livestock producers. Although para-veterinarians and CBAHWs play an essential role in providing animal health services in marginal areas or in instances where there are no veterinarians, care needs to be evaluated to inform future training programmes and policies.

Findings from a literature review show that the effectiveness of animal health care has not been evaluated in the Pacific region. Consequently, to bridge this knowledge gap, the overall objective of this study is to evaluate this effectiveness in Fiji and Samoa. This includes the appropriate use of antimicrobials and providing information that could be used to advise and influence policy on the para-veterinary training programmes in the region.

The study will take the farmer's and animal health care workers' perspectives, with the former representing the demand side and the latter the supply side of the demand, as well as supply factors in animal health service delivery. To evaluate the effectiveness of animal healthcare workers, questionnaires were disseminated to animal healthcare workers and livestock farmers. The findings showed two significant challenges faced by animal health care workers: lack of resources and lack of staff, while livestock farmers were found to face the unavailability of animal health care workers and inaccessibility to livestock drugs.

The lack of veterinarians or animal health care workers could be addressed by promoting the benefits of agriculture or, to be more specific, livestock, as it is seen to be a school subject that most Pacific Islanders are not interested in. National governments can create veterinary scholarships for studying abroad and also retain graduates and current animal health care workers with reasonable income and work conditions. Strategic partnerships, international collaboration and having an efficient resource allocation with reference to livestock production would assist animal health care workers with providing basic services for livestock farmers.

Integrating indigenous knowledge into biosecurity: Addressing the threat of rapid 'ohi'a death (ROD) to *Metrosideros spp*. and ecosystems in Aotearoa New Zealand and the Pacific region

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In Hawaii, rapid 'ōhi'a death (ROD), caused by the fungal pathogens *Ceratocystis lukuohia* and *C. huliohia*) is killing *'ōhi'a lehua* (*Metrosideros polymorpha*), a key species in the ecosystem. If introduced to Aotearoa New Zealand or the South Pacific region, these pathogens could threaten Metrosideros species and other plants. Ceratocystis species are emerging as invasive pathogens capable of adapting to new regions and attacking diverse plant species, posing a significant biosecurity risk to the region.

Our research investigates the potential impact of ROD on ecosystems and taonga plants, focusing on pathways for its spread in Aotearoa New Zealand and the Pacific region. Integrating local Indigenous knowledge (from Hawaii, Aotearoa New Zealand and the broader Pacific region) with modern science is important for developing effective strategies to address emerging biosecurity threats. We use scientific methods and kaupapa Māori methodologies, incorporating Indigenous values into fieldwork, such as seed collection and insect trapping. Drawing from Hawaii›s ROD crisis and management, we support consultation with experts (including scientists, biosecurity officials and Indigenous leaders) through *wānanga* (workshops) to gather insights. This ensures that Indigenous knowledge is embedded in surveillance, readiness and response strategies. The research stresses the need for Pacific-wide collaboration in early detection, prevention and community involvement to protect Metrosideros species and native ecosystems.

Findings so far indicate that Aotearoa New Zealand's native *Metrosideros* species may be vulnerable to ROD and that local Indigenous communities play a critical role in biosecurity through monitoring and community-based management. This ongoing study advocates for greater inclusion of Indigenous knowledge in biosecurity decision-making and regional collaboration across the South Pacific to protect biodiversity and cultural heritage. Research on the health of Metrosideros species and other vulnerable plants, along with identification of emerging threats in the South Pacific, will support biosecurity efforts and regional cooperation.

Genomic approach to address biosecurity and IPM challenges in the Pacific region

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Biosecurity action that prevents or reduces the impacts of invasive pests and diseases is widely regarded as one of the most important factors to achieve economic and food security, as well as sustainable agriculture, fisheries, and forestry. Across all habited landscapes, Pacific Island countries and territories are especially vulnerable to invasive pests and diseases, and the introduction and establishment of invasive species, such as invasive ants and coconut rhinoceros beetles (CRB), have already seriously affected farming and agricultural communities. The biological threats posed by invasive ants and CRB formed two of the three action plans developed at the Pacific Ecological Security Conference (PESC) held in Palau in 2022 and integrated into the US Defense Indo-Pacific Command conference (INDOPACOM) held in Guam in 2023.

Historically, CRB populations in their exotic range were suppressed through the introduction of the *Oryctes rhinoceros* Nudivirus (OrNV) biological control agent (BCA). However, the emergence of the 'Guam CRB' (i.e. CRB-G) populations linked with apparent increased tolerance/resistance to the OrNV has challenged prospects of the OrNV as an effective control agent. There is conflicting evidence on the spread of CRB-G across the Pacific region, and the ongoing efficacies of OrNV as a control agent to sustain farming/agricultural practices involving coconut palms.

In collaborative partnership with CRB researchers across the Pacific region, including from Solomon Islands, Fiji, Papua New Guinea, and Guam, we applied the whole genome sequencing approach to interrogate the CRB-G spread patterns, and to investigate the population genomics of CRB and its OrNV BCA to better understand the genetic diversity in this pest-pathogen biological system.

Our findings overturn much prior understanding of the genetic identity of CRB throughout its exotic range, as well as its international spread and apparent resistance to OrNV. Genetic diversity

detected in the OrNV also opens new opportunities to develop alternative/complementary CRB integrated pest management (IPM) solutions, including developing the use of multiple genetically distinct OrNV isolates to help reduce on-going CRB impact across the Pacific Islands. Our findings provided clear evidence of the need to adopt genomic techniques to improve science understanding of a biological problem, thereby enabling the implementation of appropriate biosecurity measures and to improve CRB IPM approaches.

Evaluating nitrogen availability in a tropical taro-based cropping system integrated with sheep grazing and leguminous biomass mulching

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Strategic integration of sheep grazing and application of leguminous biomass as a mulch may control weeds, whilst improving soil health – particularly by increasing labile soil organic carbon (SOC) as well as nitrogen availability – and overall crop yield. This study monitored the effects of sheep grazing along with different leguminous mulches on the mineral nitrogen (N) and labile organic matter content of Samoan Inceptisols under a taro-based cropping system. Taro was either alley cropped with leguminous trees (Sesbania, Gliricidia and Erythinia) or grown as a sole crop (control). The weed control treatments included mulch + spraying, hand weeding and sheep grazing + hand weeding.

Postharvest soil data indicated that sheep grazing significantly increased soil NH4-N, NO3-N and total soil mineral N, compared to hand weeding and mulching until 30 cm of soil depth. The synergistic effect of weed control methods with leguminous alley cropping also significantly affected the soil total N content at three soil depths until 60 cm. However, the SPAD reading of taro leaf during the harvest showed contrasting results, with a significantly higher SPAD value in hand-weeded plots (62.4), compared to mulch (55.9) and sheep-grazing plots (55.2). This indicates that taro plants in hand-weeded plots either consumed more N or matured late, possibly due to lack of N at the early growth stage.

Based on these findings, we are now monitoring N availability throughout the taro growing cycle. Thus, soil mineral N and leaf N concentrations are now monitored in two-monthly intervals for the 2025 taro crop cycle from the same plots. In addition, no significant difference in labile SOC was observed between treatments, except for relative labile SOC (percentage of total SOC) in the subsoil (15–30 cm). Relative labile SOC concentration was significantly reduced in sheep-grazed subsoil (1.93%), compared to mulch (2.66%) and hand-weeded (2.39%) treatments. This indicates the stabilisation of SOC through enhanced organic matter decomposition and microbial activity in sheep-grazed soil. Further measurements will examine the effects over time of mulching, sheep grazing and alley cropping on overall soil health and crop yield to ensure a comprehensive understanding of their agronomic benefits.

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