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ACIAR in the Indo-Pacific

Photo: Andrew Mununwa

ACIAR in the Indo-Pacific

Through longstanding partnerships with many countries in the Indo-Pacific region, ACIAR supports collaborative research on productivity, resilience, sustainability and equity in agriculture, forestry and fisheries systems to reduce poverty and improve livelihoods.

This work is dominated by bilateral and regional research projects underpinned by longstanding country partnerships. During 2022–23, 171 projects will be active in our operational area. These projects are collaborations between Australian and international scientists with in-country partners, and brokered by ACIAR research program managers, across 10 areas of research.

The projects are varied in design, execution and outcomes. Very broadly, projects range from research or investigations conducted by a group of partners across a number of field sites over several years to develop new knowledge, technology or methodology, through to small research activities where an individual agency or specialist may conduct a desktop or scoping study over 12 months.

When establishing research projects, our research program managers work closely with the ACIAR Country Network to ensure that the research aligns with in-country priorities, and to build connections and relationships with in-country organisations and institutions.

This chapter describes our research collaborations with each region and country in 2022–23. Our work is organised in 4 regions of operation in the Indo-Pacific, with 32 partner countries and guided by locally engaged staff in 11 Country Offices throughout the regions.

Within each region, we facilitate a varied program of research, reflecting the challenges and opportunities of a region and individual countries. In addition to bilateral and regional projects, we also conduct global research collaborations (Chapter 2) and scientific and policy capacity building (Chapter 6).

Pacific

52

projects

East and South-East Asia

75

projects

South Asia

28

projects

Eastern and Southern Africa

26

projects

This data was compiled in August 2022 and may change during 2022–23. Some projects occur in more than one region, therefore the total of projects in each region will exceed the total number of individual projects as listed on page 34.

5.1

Pacific

Photo: Cooper Schouten

Pacific

The countries of the western Pacific region are set apart from the rest of the world. Many are small and geographically isolated, have limited land mass and arable land, fragile natural environments and few resources. Increasingly, they are more vulnerable to natural disasters and climate change than many other regions of the world.

Each country in this region faces specific development and agricultural challenges including small formal economies, long distances from major markets, high costs and rapidly growing populations that hamper economic growth. Governance and capacity constraints in some countries also limit their ability to deliver services. These challenges make it difficult to respond and recover from disasters and climate change effects, which are prominent in the region.

In 2021–22, the region was confronted with a string of civil and natural disasters that included civil unrest and demonstrations in Solomon Islands, volcanic eruption and tsunami in Tonga, and flooding and landslides due to cyclones across several countries.

Pacific island countries also face the consequences of a triple burden of malnutrition – a situation where undernutrition, micronutrient deficiencies and obesity coexist. Unhealthy diets, lifestyles and environment are key risk factors contributing to these non-communicable diseases.

For the last 2 years, the COVID-19 pandemic has had devastating effects globally. Cities have been locked down, borders have closed, limiting international travel, and supply chains have been disrupted, upending economies. The Pacific region has been equally affected.

With the threat of inadequate health care to cope with COVID-19, Pacific countries were quick to close borders, establish isolation strategies and roll out protocols of social distancing. Many Pacific island countries have intensified their vaccination programs, including boosters to help manage the spread of the virus. Australia has assisted the region by providing donations of vaccines and support to local health systems.

In 2020 ACIAR published a report[1] that examined food systems in the Pacific region and the vulnerabilities that were exposed or amplified by the COVID-19 shock. Income and production by farmers and fishers were impacted by the movement restrictions; service delivery was disrupted, especially on small and medium islands; local markets closed reducing the availability of fresh produce, which was felt most by urban areas; tourism declined significantly reducing farm incomes that were reliant on supplying tourism establishments; and migration to rural areas increased food demand and pressure on agriculture. Lockdowns and border closures also resulted in employment and income losses, remittances declined and general household and business spending declined. In response to this analysis, ACIAR commissioned an assessment of agrifood systems transformation through circular migration between Pacific island countries and Australia[2]. This assessment concluded that the combination of continued labour demands in Australian agriculture, COVID-19 socioeconomic impacts in the Pacific, and future food systems risks in Pacific island countries, create an opportunity for greater agriculture-oriented research and training within agriculture-related labour mobility.

1 Robins L, Crimp S, van Wensveen M, Alders RG, Bourke RM, Butler J, Cosijn M, Davila F, Lal A, McCarthy JF, McWilliam A, Palo ASM, Thomson N, Warr P & Webb M (2020) *COVID-19 and food systems in the Indo-Pacific: An assessment of vulnerabilities, impacts and opportunities for action*, ACIAR Technical Report No. 96, Australian Centre for International Agricultural Research, Canberra.

2 Davila F, Dun O, Farbotko C, Jacobs B, Klocker N, Vueti E, Kaumaitotoya L, Birch A, Kaoh P, Pitakia T, Tu'itahi S (2022) Agrifood systems transformation through circular migration between Pacific island countries and Australia, ACIAR Technical Report No. 100, Australian Centre for International Agricultural Research, Canberra.

The impact of the pandemic continues to hit the Pacific region hard. Agriculture and fresh produce emerged as the foundation of the economy for the region and ensured food security for the population when the manufacturing sector, trade and services stalled.

To reduce and mitigate ongoing impacts of COVID-19 on economies, Pacific region countries adopted a variety of measures, including economic stimulus packages, home gardening programs through seed distribution, farm support packages and backyard aquaculture farms. Cash transfers to most vulnerable households were also implemented to augment loss of income.

While many Pacific region countries are still contending with and responding to the onshore surge of the Omicron variant of COVID-19, the region and governments are preparing to restart their economies and open borders. The past 2 years have resulted in renewed interest in, and support for, agriculture, fisheries and forestry; enthusiasm for innovation in food systems and value chains; and the creation of new domestic market opportunities.

Partner countries in the ACIAR Pacific region

- Fiji
- Kiribati
- Samoa
- Solomon Islands
- Tonga
- Tuvalu
- Vanuatu
- Papua New Guinea

Drivers of regional collaboration

While acknowledging the individual needs and unique research and development priorities of each partner country in the Pacific region, the scattered nature of the Pacific region nations and their small populations mean that many countries cannot address all their challenges and opportunities in agriculture alone.

The ACIAR program with the Pacific region has a strong focus on enabling regional collaboration, especially through our close relationship with The Pacific Community (SPC), which plays a key role in communicating research outcomes of relevance across the region. Regional research programs and projects are implemented through agencies with regional capability (including SPC, the University of the South Pacific and CGIAR centres) and bilateral research and extension agencies.

Papua New Guinea is a significant partner within our Pacific region program, and we have a specific strategy that highlights enabling collaboration with the small island states of the region on issues of common interest.

ACIAR research projects are designed with consideration for sustainable and inclusive economic development, such as projects in the highlands of Papua New Guinea where crop production and crop protection research enables growers to supply more product to local markets. ACIAR Research Program Manager, Horticulture, Irene Kernot (centre), visited a market with research team members to learn more about project impacts.

ACIAR alumnus and Senior Research Officer, Fiji Ministry of Agriculture, Dr Rohit Lal, leads soils training in Taveuni, Fiji. The soils training aims to help farmers learn to recognise soil nutrient deficiencies and ways to improve soil health. Photo: Sunayna Nandini

ACIAR Pacific region program

The 2017 Pacific Step-up highlighted in the Australian Government's 2017 Foreign Policy White Paper elevated Australia's partnerships with the Pacific region to a new level and focused on strategically secure and economically stable support for the region. This strong focus was re-emphasised by Australia's new government in 2022.

In 2022–23, we will continue to build on our long engagement with the Pacific region, through our regional office in Fiji. We will develop new 10-year strategies with the Pacific island states and Papua New Guinea.

We are developing our medium-term priorities under both 10-year strategies through consultation with national government partners and regional research and development agencies as the region enters the new normal. We will focus our efforts on re-building the agriculture sector post-pandemic and re-engaging with partners, including face to face discussions where possible. We are also supporting Pacific Week of Agriculture and Forestry, which Fiji will host in March 2023.

We continue to support alumni of ACIAR capacity building programs and fellowships to work hand-in-hand with Australian researchers to provide insights into how the pandemic is affecting local food security and to ensure future food security of the Pacific region. We also support the scaling up of new opportunities in COVID-19 relevant research areas such as One Health (the interface between human, animal and environmental health), biosecurity and improving resilience in food supply chains, both within partner countries and between Australia and partner countries.

A key focus of our program within the Pacific region will be enabling regional collaboration in research and capacity building to address common issues and opportunities. This regional approach includes various projects addressing biosecurity, climate-resilient livelihoods and opportunities for stronger agribusiness development. Multi-country projects and linked programs include:

- fisheries (pathways to change in Pacific coastal fisheries)
- forestry (domestication and breeding of sandalwood, agroforestry and catchment rehabilitation)
- crops (sweetpotato, indigenous vegetables, commercial vegetables, tropical fruits and cocoa)
- soil information and soil health.

Pacific region program 2022–23

Partner country	No. projects
Pacific island countries	34
Fiji	20
Kiribati	4
Samoa	13
Solomon Islands	14
Tonga	11
Vanuatu	9
Papua New Guinea	22

Note that a project may be conducted in several countries, therefore the total number of projects in this table will be greater than the number of projects in the region.

52 projects

37 research projects

15 small research activities

This data was compiled in August 2022. Additional projects may be commissioned during 2022–23.

Research portfolio

3 Agribusiness projects

5 Climate Change projects

1 Crops project

9 Fisheries projects

6 Forestry projects

11 Horticulture projects

6 Livestock Systems projects

7 Social Systems projects

4 Soil and Land Management projects

0 Water projects

Table 5.1 Current and proposed projects in the Pacific region, 2022–23

Project title	Project code	Country
Agribusiness		
Pacific Agribusiness Research in Development Initiative Phase 2 (PARDI 2)	AGB/2014/057	Fiji, Tonga, Vanuatu
Defining priority commercialisation pathways and potential private commercialisation partners for viable long-term commercialisation of products emerging from FST/2019/128	AGB/2021/172	Fiji
Landscape and opportunity analysis in the Pacific tuna sector: Foundation analysis to identify innovation pathways to enhance participation by the Pacific community and value retention in the region	AGB/2021/173	South Pacific general
Climate Change		
Transformation pathways for Pacific coastal food systems	CLIM/2020/178	Kiribati, Solomon Islands
Sustainable intensification for climate-resilient development in Pacific island countries	CLIM/2020/186	Samoa, Tonga
Institutional barriers to climate finance through a gendered lens in Fiji, Samoa and Solomon Islands	CLIM/2021/110	Fiji, Samoa, Solomon Islands
Supporting greenhouse gas inventories and livestock data development in Fiji	CLIM/2021/160	Fiji
Supporting the tracking sharing learning platform of the Adaptation Research Alliance	CLIM/2022/108	Global
Crops		
Finding a genetic basis for oil palm responses to basal stem rot in a long-term infected block	CROP/2021/130	Papua New Guinea, Solomon Islands
Fisheries		
Half-pearl industry development in Tonga and Vietnam	FIS/2016/126	Tonga, Vietnam
Improving peri-urban and remote inland fish farming in Papua New Guinea to benefit both community-based and commercial operators	FIS/2018/154	Papua New Guinea
Agriculture and fisheries for improved nutrition: integrated agrifood system analyses for the Pacific region	FIS/2018/155	Kiribati, Solomon Islands, South Pacific general, Vanuatu
Towards more profitable and sustainable mabé pearl and shell-based livelihoods in the western Pacific	FIS/2019/122	Fiji, Papua New Guinea, Samoa, Tonga
Innovating fish-based livelihoods in the community economies of Timor-Leste and Solomon Islands	FIS/2019/124	Solomon Islands, Timor-Leste
Improving nutrition through women's and men's engagement across the seaweed food chain in Kiribati and Samoa	FIS/2019/125	Kiribati, Samoa
Spatially integrated approach to support a portfolio of livelihoods	FIS/2020/111	Solomon Islands, South Pacific general
Coalitions for change in sustainable national community-based fisheries management programs in the Pacific	FIS/2020/172	Kiribati, Solomon Islands, South Pacific general, Vanuatu
Strengthening agricultural resilience in Western Province: Developing methods for strengths-based livelihoods approach	FIS/2021/113	Papua New Guinea
Strengthening agricultural resilience in Western Province: Mapping place-based strengths and assets	FIS/2021/122	Papua New Guinea

Project title	Project code	Country
Forestry		
Enabling community forestry in Papua New Guinea	FST/2016/153	Papua New Guinea
Enhancing private sector-led development of the canarium industry in Papua New Guinea - Phase 2	FST/2017/038	Papua New Guinea
Promoting smallholder teak and sandalwood plantations in Papua New Guinea and Australia	FST/2018/178	Papua New Guinea
Coconut and other non-traditional forest resources for the manufacture of engineered wood products	FST/2019/128	Fiji
Livelihoods in forest ecosystem recovery	FST/2020/135	Solomon Islands
Kava land use changes	FST/2021/146	Fiji, Vanuatu
Horticulture		
Adopting a gender-inclusive participatory approach to reducing horticultural food loss in the Pacific	CS/2020/191	Fiji, Samoa, Solomon Islands, Tonga
Aligning genetic resources, production and post-harvest systems to market opportunities for Pacific island and Australian cocoa	HORT/2014/078	Fiji, Samoa, Solomon Islands, Vanuatu
Developing the cocoa value chain in Bougainville	HORT/2014/094	Papua New Guinea
Responding to emerging pest and disease threats to horticulture in the Pacific islands	HORT/2016/185	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga
Safeguarding and deploying coconut diversity for improving livelihoods in the Pacific islands	HORT/2017/025	Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu
Protecting the coffee industry from coffee berry borer in Papua New Guinea and Australia	HORT/2018/194	Papua New Guinea
Improving root crop resilience and biosecurity in Pacific island countries and Australia	HORT/2018/195	Fiji, Samoa, Solomon Islands, Tonga
Enhanced fruit systems for Tonga and Samoa (Phase 2): Community based citrus production	HORT/2019/165	Samoa, Tonga
PICfood: Driving vegetable food environments to promote healthy diets in Pacific island countries	HORT/2021/141	Fiji, Samoa
Biosecurity planning	HORT/2021/151	Cambodia, Papua New Guinea
Understanding school food provision in the Pacific: Scoping the potential of local food systems to improve diets, nutrition and livelihoods	HORT/2021/159	Fiji
Livestock Systems		
Increasing the productivity and profitability of smallholder beekeeping enterprises in Papua New Guinea and Fiji	LS/2014/042	Fiji, Papua New Guinea
Improving small ruminant production and supply in Fiji and Samoa	LS/2017/033	Fiji, Samoa
A farm planning approach to increase productivity and profitability of smallholder cattle systems in Vanuatu	LS/2018/185	Vanuatu
Drug sensitive and resistant tuberculosis and zoonotic infections as causes of lymphadenitis in 3 provinces in Papua New Guinea	LS/2018/217	Papua New Guinea
Development of a third party verified voluntary sustainable certification program for beef and other key commodities in Vanuatu	LS/2020/155	Vanuatu
Strengthened surveillance for vector-borne zoonotic and livestock diseases in Papua New Guinea	LS/2021/158	Papua New Guinea

Project title	Project code	Country
Social Systems		
Improving livelihoods of smallholder coffee communities in Papua New Guinea	ASEM/2016/100	Papua New Guinea
Climate-smart landscapes for promoting sustainability of Pacific island agricultural systems	ASEM/2016/101	Fiji, Tonga
Climate-smart agriculture opportunities for enhanced food production in Papua New Guinea	ASEM/2017/026	Papua New Guinea
Improving agricultural development opportunities for female smallholders in rural Solomon Islands	SSS/2018/136	Solomon Islands
Gender equitable agricultural extension through institutions and youth engagement in Papua New Guinea	SSS/2018/137	Papua New Guinea
Landcare: An agricultural extension and community development model at district and national scale in Fiji	SSS/2019/140	Fiji
Climate-smart coastal landscapes for sustaining fisheries-based livelihoods and food security in the Pacific	SSS/2021/120	Fiji, Tonga
Soil and Land Management		
Better soil information for improving Papua New Guinea agricultural production and land use planning: Building on PNGRIS and linking to the Pacific Regional Soil Partnership	SLAM/2019/106	Papua New Guinea
Optimising soil management and health in Papua New Guinea integrated cocoa farming systems - Phase 2	SLAM/2019/109	Papua New Guinea
Soil management in Pacific island countries Phase 2: Investigating nutrient dynamics and the utility of soil information for better soil and crop management	SLAM/2020/139	Fiji, Samoa, Tonga, Vanuatu
Sustaining soil fertility in support of intensification of sweetpotato cropping systems	SMCN/2012/105	Papua New Guinea

Pacific island countries

A$11.85 million
Budgeted funding

26
Bilateral and regional research projects

9
Small projects and research activities

Agriculture, fisheries and forestry are vital sectors for the majority of Pacific island communities and countries, because of their contributions to rural livelihoods, gross domestic product (GDP) and food security, as well as increasing opportunities for local regional and international markets.

The Multi-Country Programming Framework for the Pacific Islands 2018–2022, developed in partnership with the Food and Agriculture Organization of the United Nations (FAO), identified the following common challenges across the Pacific island countries:

- limited land mass and dispersed population
- fragile natural environments and lack of arable land
- narrow resource bases and reliance on ocean resources
- high vulnerability to climate change, external economic shocks, and natural disasters
- exposure to increasingly frequent and more intense severe weather and climate events, including droughts, floods and tropical storms
- high dependence on food imports
- dependence on a limited number of economic sectors
- remoteness and distance from global markets
- high costs for energy, transportation and communication.

These constraints interact with one another and contribute to increased vulnerability to shocks – both economic shocks (such as abrupt changes in food and fuel prices) and natural disasters (such as cyclones, floods and droughts, earthquakes and tsunamis). These vulnerabilities have limited the development of commercially oriented agriculture, fisheries, and forestry sectors and left many Pacific island countries heavily dependent on imports of food and other commodities.

The vulnerability of Pacific island countries is increased by their narrow resource base, which implies the economic dependence of many islands on exports of a single commodity or limited range of commodities.

For much of the twentieth century, most Pacific island economies were heavily dependent on copra as their principal source of export income; however, with the falling value of coconut oil, this previous source of wealth has become a ‘poverty trap’ for many communities and countries that lack the resources to diversify into higher value products (which could support the rejuvenation of the industry) or into other crops and commodities.

Other countries are heavily dependent on marine resources, especially tuna, for their export earnings. In this case, significant vulnerability arises from the limited control that each country has over the management of this resource. An emerging threat is that rising sea temperatures, especially when accentuated by El Niño cycles, may affect the migration of some tuna species, potentially taking fish populations out of the waters of Pacific island countries that depend heavily on them economically.

Dependence on logging – and especially the export of round logs – is a challenge in western Melanesian countries (Papua New Guinea, Solomon Islands and, to a lesser extent, Vanuatu). The natural forest resource is declining rapidly, often accompanied by serious environmental degradation, and exploitation brings little lasting benefit to landowners or to the national economy. Partner countries wish to move towards more sustainable management of forest resources and local processing to add value to the timber but lack the economic resources and skills to make this transition.

This context is not static but evolves on a number of scales, in time and space. Changing demographics are one key factor, with populations increasing at more than 2% per annum in Solomon Islands and Vanuatu (as well as Papua New Guinea), leading to mounting concerns about local food security and increasing pressure on the natural resource base. Elsewhere in the Pacific region, populations are either stable (increasing at less than 1% per year) or falling (due to emigration), leading to labour shortages and making it harder to develop profitable enterprises. Additionally, there is a strong move towards urbanisation across the Pacific region, with more than one-third of the total population now living in cities. This has disrupted traditional food systems and diets and is leaving some rural areas and outlying islands with declining populations, hampering economic development and making it hard for governments to assure basic services.

Another widespread vulnerability of Pacific islands agriculture – though with different impacts in each country and island – is to invasive pests and diseases. Island environments have inherently limited natural resilience in the face of aggressive invasive species due to the limited local diversity of 'natural enemies'. Recent years have been marked with rapidly spreading outbreaks of, for instance, invasive ant species, the destructive 'Guam strain' of the familiar coconut rhinoceros beetle, and the giant African snail. Emerging diseases of livestock (and potentially fisheries) may be equally destructive, even if less visible to the general public.

Pacific region leaders have repeatedly identified 2 overriding threats to the economic development and wellbeing of people in the region:

1. **Climate change and its impact on food systems**

   Pacific island countries are disproportionately affected by climate change, while having little scope to influence the drivers of climate change. All countries in the Pacific region are concerned about the potential impacts of climate change on rising sea levels (given that much of the population and most of the productive agriculture in the Pacific islands is in coastal areas or coastal plains), food systems (including new threats from invasive pest species) and on their fragile marine resources.

2. **Rapid rise in non-communicable diseases, associated with declining diet quality**

   While under-nutrition remains a problem in some poorer, rural areas of Pacific island countries, changes in diets and lifestyles associated with increasing incomes and urbanisation have led to Pacific island countries having some of the highest levels of obesity in the world, along with record levels of Type II diabetes and heart disease. As well as taking a tragic toll in terms of human wellbeing, this rise in the incidence of non-communicable diseases imposes a huge burden on health services and the economy of Pacific region countries in general.

Fijian farmer, Mr Emosi Ravato, uses a high tunnel (a plastic covered structure) to increase production of certain crops, increase the length of the growing season and grow crops that otherwise could not be grown in his area. Photo: Central Queensland University

Given these challenges, Pacific leaders have strongly emphasised the need for greater resilience in Pacific region food and agriculture systems as a means to counteract vulnerabilities and to increase food and nutritional security. While investing in agriculture fisheries and forestry has been widely recognised as one of the most effective ways of stimulating broad-based economic growth, the effort to increase resilience, rather than focusing primarily on increasing productivity, has become a theme that underpins the entire agricultural development agenda in the Pacific region. Given the scale and complexity of the problems faced by Pacific island partner countries, it is fortunate that the Pacific region has a strong tradition of multilateral and bilateral institutions and partnerships that have supported many decades of collaboration and concerted action, to address a wide range of issues.

The Pacific Islands Forum provides the overall framework for policy development and action, while the technical agencies, especially the Pacific Community (SPC) and the Secretariat of the Pacific Regional Environment Programme (SPREP), provide support to member countries in taking action across a range of sectors and development issues, including health, education, the environment, biosecurity, trade, communications and infrastructure.

ACIAR has been a leading supporter of regional and bilateral research collaboration in the region with SPC, partner countries and other agencies, in agriculture, forestry and fisheries. These existing relationships provide a vital foundation for a portfolio of integrated and cross-sectoral research that will be needed to tackle the 2 high level challenges outlined above. ACIAR started working with partners in the Pacific region in 1983 and, for the next 2 decades, the majority of projects were sectorally and technically focused.

Country priorities

The ACIAR 10-Year Strategy 2018–2027 positions the agency's support to the Indo-Pacific region. Following the 2017 White Paper Pacific Step-up. Stepping up Australia's engagement with our Pacific family, ACIAR placed greater emphasis on supporting Australia's 'near neighbours' in the Pacific region. This was in response to the significant long-term challenges faced by our partners in the Pacific region, including: climate change and responding to natural disasters; sustaining economic growth and boosting education, developing skills and jobs for growing populations; pursuing gender equality and recognising the essential role of women in achieving better development outcomes; preventing major disease outbreak and tackling transnational crime.

Our regional partner SPC emphasises integrated approaches to increasing resilience, including:

- deploying a diversity of species and products in trees, crops, livestock and aquaculture to increase resilience in the face of uncertainty
- growing a greater number and diversity of trees in forestry, agroforestry and horticulture systems to contribute to more sustainable and resilient agricultural landscapes
- diversifying crops to contribute to greater food security, nutrition and health
- better managing coastal fisheries and aquaculture to underpin healthier nutrition and more resilient livelihoods
- strengthening market chains for greater equity and inclusion to contribute to improved and more resilient livelihoods.

Across the board, trans-disciplinary approaches are needed to reduce the vulnerability of the natural resource base and create climate-smart agricultural landscapes. Using national policy, land-use planning and community engagement to manage water, soils, livestock, crops, forests, natural vegetation and coastal marine resources, from 'ridge to reef', in an integrated manner can increase resilience and sustainably improve livelihoods. But achieving this will require numerous, well-coordinated technological innovations and ways of working.

ACIAR currently works with 7 Pacific island countries: Fiji, Kiribati, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

2022–23 research program

- **35 ACIAR-supported projects in Pacific island countries**
- **28 projects are specific to one or more of these countries**
- **7 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Pacific island countries. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

The viability of the coconut sector in the Pacific region is being challenged by the increasing proportion of coconut palms becoming senile. Many farmers are reluctant to renew palms due to the initial cost and reduced income until the newly planted palms yield fruit. A current ACIAR-supported forestry project is exploring the sale of senile stems by farmers to the timber industry, with revenue from sales expected to act as an incentive for farmers to remove the senile palms and offset the costs of replanting. A small research activity led by Mr Ian Buck of Buck Advisory will develop a framework for directly engaging private sector partners in the project to ensure new value chains for coconut veneer timber products are connected to viable markets via committed and capable processing and marketing entities. This framework will be applicable to other projects where understanding the business operating environment and engagement of suitably qualified private sector partners are essential to maximising the adoption and uptake of project lessons and outcomes.[1]

The Pacific Agribusiness Research and Development Initiative (PARDI) has been a significant program of work supported by ACIAR and DFAT. Starting in 2010, it promoted sustainable livelihood outcomes for Pacific islands households through research and innovation, with the regional goal of catalysing and informing a more vibrant, diverse and viable agribusiness sector. Phase 2 of PARDI, led by Professor Steven Underhill of the University of the Sunshine Coast, studied benefits to community livelihoods from successful agribusiness developments and ways to make economic benefits more inclusive and sustainable. Concluding in 2022, the project will finalise the delivery and evaluation of mentoring programs tailored to the honey, tilapia and agritourism sectors, provide technical and supervisory support to master students at partner universities, and develop and trial a profitability and accounting tool for smallholder beekeepers.[2]

Tuna is recognised as one of the greatest shared natural resources of Pacific island countries, providing jobs, government revenue and contributing to meeting the nutritional needs of the Pacific island communities. However, population growth, climate change and overfishing have placed increasing pressure on the sustainability of tuna resources. A small research activity led by Ms Deb Doan of Business for Development will identify innovation pathways and assess the commercial feasibility for improving returns (defined as sustainable resource management, maximum catch utilisation and increased retention of value) for Pacific island countries' tuna sectors and economies more broadly. Researchers will analyse previous projects to identify key barriers to success and critical success factors.[3]

Climate Change

Australia is a world leader in greenhouse gas mitigation research in agriculture. A new project in 2022–23 works with Fiji to strengthen its national greenhouse gas accounting systems for livestock towards the same high standard used by Australia and to use these systems to support the identification and implementation of on-farm management options that reduce emissions. The project supports the implementation of Fiji's Low Emission Development Strategy. Led by Dr Natalie Doran-Browne of Riverine Plains Inc, the project team will work with government institutions in Fiji and will help grow capability in the data management, analyses and reporting needed to support current and future emissions reduction commitments under the Paris Agreement. The project team will also collaborate within Fiji and across the region to support Pacific greenhouse gas inventory systems.[4]

Evidence suggests that responding to climate change requires collaboration, learning and community-based participatory processes – all 'softer' types of response that are rarely formally supported through institutional mechanisms. A small research activity, led by Dr Rowena Maguire of Queensland University of Technology, is exploring whether the relative lack of institutional support for 'softer' types of climate response, and the underrepresentation of women and particular cultures, are linked, acting as both causes and consequences of the insufficient action on climate change. The team will conclude the research with a multi-country workshop and the production of 3 country case studies. The research team will present their findings at COP27.[5]

The impacts of climate change and population growth are projected to lead to the collapse of coastal livelihoods dependent on coral reef-based fish and nearshore fish throughout Pacific island countries. Different food and livelihood options need to be progressed in ways that are owned and driven by local communities, facilitated by governments and civil society groups. Led by Dr James Butler of the Cawthron Institute, a new project will combine scientific analysis and local knowledge about pathways toward novel and transformative circular food production options, and develop the transformative capacity needed in local communities to identify leverage points and create transformative change.[6]

Smallholder farmers in Pacific island countries are vulnerable to reductions in the availability of fresh water under climate change and increasing demands from growing populations. Co-led by Professor Timothy Reeves and Dr Dorin Gupta of the University of Melbourne, the project will explore opportunities for sustainable intensification systems in smallholder farming systems in Samoa and Tonga. In other parts of the world, these systems which combine multiple interventions for benefits that may be 'more than a sum of the parts' have been successful in intensifying agricultural production while providing climate adaptation and mitigation benefits. This project will investigate whether such integrated management changes may help Pacific island countries in similar ways.[7]

Basal stem rot is a fungal disease that kills oil palm in plantations across South-East Asia and the Pacific region. An ACIAR-supported project is studying the eggectiveness of removing infected dead trees to reduce inoculum pressure (CROP/2021/130).

Crops

Basal stem rot is a fungal disease that kills oil palm in plantations across South-East Asia and the Pacific region. Growers have limited options to manage the disease. New trees are planted after the death of the infected trees but experience suggests that the incidence of the fungus seems to increase with each successive planting. Removing infected dead trees may reduce inoculum pressure but is costly and the benefit has not yet been demonstrated. A new research activity in 2022, led by Dr Agnieszka Mudge of the University of Queensland will continue monthly monitoring of an experimental plot established 11 years ago. Data will be analysed to determine if infection dynamics and impact differ between genetically characterised families of trees and if there is a difference between lots where infected stem bases and roots of dead trees are removed compared with plot where they are left in place.[8]

Fisheries

Unique among Pacific island countries is the production of half-pearls, or mabé, in Tonga from the winged pearl oyster. Although half-pearls are generally less valuable than round pearls, an individual oyster can produce multiple half-pearls (unlike round pearls). With appropriate training, pearl production can be accomplished by community members over a 10-month culture period, compared to approximately 2 years for round pearls. Professor Paul Southgate of the University of the Sunshine Coast completes a project in 2023 that is supporting further expansion of community-based pearl farming and handicraft production in Tonga and demonstrating the feasibility of similar development in Vietnam.[9]

Mabé (half-pearl) jewellery and shell handicraft industries provide income opportunities for coastal communities and women's social enterprises in the western Pacific. Previous projects have increased the technical skills of communities in producing juvenile oysters, farming mabé shell in Fiji and Tonga, and producing shell-based jewellery in Papua New Guinea. The development of greater technical capacity and a better understanding of gendered preferences and aspirations sets the basis for a new project in Fiji, Tonga, Papua New Guinea and Samoa, led by Professor Paul Southgate of the University of the Sunshine Coast. Country-specific interventions are required to ensure uniform mabé pearl jewellery/shellcraft production protocols and standards, improve capacity for sector governance within partner institutions and stakeholders, develop marketing strategies and ensure optimal benefits flow to both women and men across the value chains.[10]

In the Pacific region, there is an opportunity to transform seaweed fisheries into nutritionally sensitive food systems comprised of short supply chains, village-based processing, sustainable use of natural resources and marketing for families. Nutrition-sensitive agriculture ensures the sustainable production of nutritious, affordable and safe foods to meet the dietary requirements of local communities. Dr Libby Swanepoel of the University of the Sunshine Coast will complete a small research activity in 2022 that is designing a framework for equitable empowerment of women and men within seaweed harvester families. This will be achieved by developing and evaluating gender-inclusive activities in Kiribati and Samoa that broaden the focus of seaweed production from an export commodity to one that provides direct benefits to the health and wellbeing of communities.[11]

In Pacific island countries, the paradox of apparently abundant fish, vegetables and root crops but poor public health outcomes presents a significant challenge for policymakers. Professor Neil Andrew of the University of Wollongong leads a project that has analysed regional agrifood systems using newly integrated data sources that allow mapping and analysis of what food is being produced, distributed, traded and sold. During 2022–23, the analysis results will continue to inform regional and national policy. Diagnostic tools developed by the project will be linked to methods that pertain to different nodes of the agrifood system to form an overarching 'agrifood system diagnostic' that can highlight the key challenges and opportunities in the Pacific agrifood system.[12]

Securing the sustainable supply of coastal fish is a development priority for Pacific countries and regional organisations, as coastal fisheries are important for food and nutrition security and economic development. A project led by Dr Dirk Steenbergen of the University of Wollongong aims to scale up the proven approach of community-based fisheries management in Kiribati, Solomon Islands and Vanuatu to self-sustaining national programs that support resilient coastal communities. The project also aims to drive the spread of community-based fisheries management throughout the Pacific region. In 2022–23 the project team will implement an awareness raising strategy, assess food and nutrition security in the scaling of community-based fisheries management and develop a centralised information management system to monitor the impact of information dissemination activities.[13]

Livelihood improvement projects for small-scale fishing communities are increasingly promoted in the Pacific region to build resilience to global change and dwindling fisheries resources. Often these projects focus on a single sector and individual communities and households, failing to acknowledge the complexity of people's livelihoods. Such projects also risk obscuring broader-scale economic development trends, such as the establishment of extractive industries or technological innovations. Dr Amy Diedrich of James Cook University leads a small research activity to establish an integrated livelihoods approach to guide scientists, practitioners and decision-makers engaged in livelihood improvement project planning and assessment. The improved approach aims to achieve 3 desired outcomes in Pacific coastal communities: a fair and just society, sustainable natural resource use and resilient livelihoods.[14]

Fish-based livelihoods play a critical role in the economies of coastal communities in Solomon Islands and Timor-Leste, and participation in catching, processing or trading of fish is an important pathway to poverty reduction. A project led by Dr Hampus Eriksson of the University of Wollongong will identify and support community-identified opportunities for innovation within the coastal fisheries post-harvest sector, focusing on income benefits. This new approach addresses the historic lack of success at the community level of large state-led investments in fisheries sector infrastructure and advanced technologies. It seeks to influence policy on how fisheries institutions can support remote communities through appropriate community-led infrastructure and skill development investments. In 2022–23 activities will include monitoring fish distribution and marketing, documenting livelihood experiences and building the capacity of women in safe aquatic food handling practices.[15]

Coastal fisheries are critical for providing food security and local employment across the Pacific region. Increasingly ACIAR-supported projects are focused on building resilience to global change and dwindling fisheries resources. Photo: Conor Ashleigh

Forestry

Renewal of the coconut estate is a priority for governments, development agencies and researchers throughout the Pacific region. In Fiji, a project led by Dr Rob McGavin of the Queensland Department of Agriculture and Fisheries strives to create market pull for senile coconut stems by converting them to high-value engineered wood products. A market for old palms will encourage coconut growers to remove them, reducing phytosanitary risk and incentivising new, more productive planting. The project will deliver and validate wood-processing technologies to transform coconut and other low-value forest resources into high-value products suitable for local and international markets. In 2022–23, the project team will focus on mapping senile coconut stands and identifying opportunities to promote gender equity within the value chain.[16]

Kava is a major cash crop in the Pacific region and a revered, traditional crop, grown for at least 3,000 years. Using time series geospatial data and ground truthing, this project will examine changes in the area and methods of kava cultivation in leading Pacific region producer countries, Vanuatu and Fiji. Kava is becoming big business, with the number of producers, production, sales, revenue and exports climbing. Governments and aid agencies are promoting the kava industry, but kava cultivation has resulted in deforestation. Researchers aim to assess land cover change from kava cultivation and to consider whether environmental harm is resulting and can be mitigated.[17]

Although primary forest reduction is significant, Solomon Islands economy and livelihoods remain dependent on forests. Logging royalties account for 60% of government revenue and 92% of the population are subsistence cultivators who supplement their material economy with forest-derived building materials, food, fuel, medicines, tools and household items. Professor Helen Wallace of Griffith University leads a new project with the central aim of learning how to efficiently restore forests to meet critical needs of rural Solomon Islanders, accelerating and channelling forest development to support livelihoods. The project also strives to support positive leadership in forest governance to secure remaining forests and those restored. Starting in 2022 are activities to foster community ownership and enhance women's participation, as well as a review of restoration methods for logged forests and establishment of field sites to measure the impact of interventions.[18]

Horticulture

School meals programs based on home-grown models can serve as platforms for transforming food systems while improving education quality. A small research activity led by Dr Sarah Burkhart of the University of the Sunshine Coast aims to understand the current extent and status of school food provision and environments in Pacific island countries. The research will identify and enhance nutrition-sensitive institutional food procurement opportunities, including school feeding programs, to provide reliable markets for small-scale producers in Fiji. It will also investigate the potential to scale-up school feeding initiatives in the Pacific region.[19]

Developing safe, high-value fruit and vegetable industries is a priority for many Pacific island countries. Dr Michael Furlong of the University of Queensland leads a project to develop integrated pest and disease management strategies for the sustainable intensification of fruit and vegetable crop production, addressing the threats posed by the inappropriate use of pesticides, emerging pests and diseases and climate change. During 2022–23, the project will focus on providing technical training for extension staff and conducting in-country plant health clinics and pesticide awareness workshops. The project will continue to build surveillance and diagnostic capacity for managing emerging pests and diseases, including fall armyworm. The project will generate new knowledge, resources and opportunities to encourage the adoption of integrated management strategies.[20]

Coconuts contribute, directly and indirectly, to the livelihoods of coastal communities throughout the Pacific region. Much of the coconut resource in the Pacific region is ageing or already senile and unproductive. A project led by Dr Carmel Pilotti of SPC aims to support the first step in rejuvenating coconut-based livelihoods in the Pacific islands by strengthening the conservation and use of genetic diversity in coconuts, addressing threats posed by the rhinoceros beetle and Bogia coconut syndrome, and establishing and sustaining a platform for coordinating coconut research-for-development initiatives. In 2022–23 researchers will focus on training staff in field transfer of plantlets derived from embryo culture and identifying key varieties for preservation in the new cryopreservation facility that will be built and commissioned.[21]

Increasing vegetable consumption is a key food system change required in the Pacific region to address malnourishment. Mrs Aradhana Deesh (right) is pictured with vegetable seedlings, she has grown as part of an ACIAR-funded research project for ACIAR alumni. Photo: Sunayna Nandini

In the Pacific region, vulnerability of horticultural produce to post-harvest losses is often more dependent on where and how a product is grown, transported and sold, rather than on the commodity-type. A new project in Samoa, Fiji, Solomon Islands, Tonga and Vanuatu aims to reduce food losses through a market-based and gender-inclusive approach to identify where food loss is greatest. Dr Seeseei Molimau-Samasoni of the Scientific Research Organisation of Samoa will lead a project team to identify value chains of fruits, vegetables and root crops that are most critical to improving nutrition and livelihoods of farmers and vendors. The team will then engage with farmers and vendors to trial interventions to address these drivers of food loss, with the ultimate goal of reducing food losses. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).[22]

Sweetpotato is a necessary component of food, nutritional security and disaster reduction strategies in Pacific island countries. Rapid production of planting material, ease of planting, quick maturation and high nutrition makes sweetpotato an ideal option in disaster recovery. However, yields of sweetpotato are low in the Pacific region compared with developed countries, as farmers do not have access to pathogen-free planting material. In times of high demand, under government assistance schemes following natural disasters, quality cuttings are not available, and those distributed are invariably infested with pests and diseases. Dr Julie O'Halloran of the Queensland Department of Agriculture and Fisheries leads a new project that has the overall aim of building capacity in the provision of high-quality, pathogen-tested sweetpotato planting material to support a larger program for resilient root cropping systems that are responsive to the challenges of pests and diseases and climate change.[23]

Cocoa is an important agricultural export for more than 50,000 households in Papua New Guinea, Solomon Islands and Vanuatu. Significant domestic and potentially useful export opportunities also exist in Samoa and Fiji. A project led by Mr Yan Diczbalis of the Queensland Department of Agriculture and Fisheries is strengthening cocoa value chains in Pacific island countries, as well as in Australia. In 2022–23, the project will complete activities that deliver market-oriented strategies for the exchange and dissemination of superior cocoa genetic resources, methods for intensifying production systems to meet market opportunities and systems for improved post-harvest handling.[24]

Pacific island countries are some of the most malnourished in the world, with among the lowest vegetable availability and consumption globally. Increasing vegetable consumption is a key food system change, but the barriers and opportunities to vegetable consumption are not currently well understood. The PICfood project aims to assess food environments in Fiji and Samoa, strengthen links between agriculture and health and identify the most important entry points for food system change towards increasing the diversity of vegetables consumed. Research findings and citizen food forums will inform agriculture, food and nutrition policy and practice for healthy diets in the Pacific.[25]

Fruit industry development in the Pacific region enhances food security, rural economies and healthy eating initiatives. A previous project in Fiji, Samoa and Tonga worked towards these benefits by supporting the development of resilient value chains for 5 regionally significant fruit crops: papaya, pineapple, mango, breadfruit and citrus. A new project led by Professor Steven Underhill of the University of the Sunshine Coast will build on the community and school-based citrus orchards established in the first project using introduced improved planting stock. The project will develop viable and sustainable fruit value chains, enhance the local capacity to support these chains, and gain wider human health impacts by piloting school and community healthy eating gardens.[26]

Livestock Systems

Strong domestic demand for honey and the potential to export honey and its by-products offers an opportunity to smallholder farmers in Fiji and Papua New Guinea. A project, led by Dr Cooper Schouten of Southern Cross University, aims to increase the productivity and profitability of beekeeping enterprises to complement smallholder incomes and promote an income-earning activity for women. During 2022–23, the project will continue to develop best-practice pest and disease management programs, particularly in readiness for incursions of varroa and tropilaelaps mites. Development of post-harvest quality management programs for producers and packers will continue, for standards, certification and testing processes for export grade honey. The project will also provide capacity building opportunities for beekeeping associations to support smallholder industry development.[27]

The productivity and profitability of sheep and goat production in Pacific island countries could be improved if domestic production was better aligned with national market requirements and smallholder farmers could more easily participate in value chains. Dr Frances Cowley of the University of New England leads a project addressing the constraints to production efficiency for smallholder and semi-commercial sheep and goat production systems in Fiji and Samoa. During 2022–23, the project will continue the on-farm monitoring program to understand the use and costs of feed resources on farms and reproductive productivity and stock losses, across the course of a year. Innovative feed systems, such as fodder banks and creep feeding, will be demonstrated and trialled.[28]

Increasing smallholder cattle productivity and income from cattle sales is a priority of the Vanuatu Government. A project led by Dr Simon Quigley of the Central Queensland University aims to integrate recommendations from previous and new research on cattle production and marketing. A set of best-bet production options will be formulated, from which smallholder farmers can develop their own cattle farming business plan using the Cattle Farm Planning Tool (a decision-tree framework). Local support agency staff will be trained to mentor farmers in the implementation of cattle farming plans. The project will also start studies to determine low-input interventions, such as improved grazing management, introduction of legumes and improved animal management, to increase productivity and farm-gate prices for smallholder cattle.[29]

In Vanuatu, meat exports are processed through 3 vertically integrated abattoirs. Smallholder beef producers in Vanuatu are largely excluded from these high-value export markets because of poor quality, insufficient quantity, poor organisation and high transport costs. Dr Cherise Addinsall of Southern Cross University will undertake a feasibility analysis to determine if greater equity and inclusivity between smallholders and large cattle producers could occur through an agritourism approach, linking a high-value, sustainable beef brand to Vanuatu's tourism industry. The project concludes in 2022, with the development of a proposed design, recognised standards and governance structure of a third party verified voluntary sustainable certification program for key commodities (beef, cocoa, coffee and agritourism).[30]

ACIAR-supported projects have enabled cattle farmers in Vanuatu to increase on-farm productivity and cattle sales through accredited abattoirs, which is a critical step to increase national beef production and meet expanding market opportunities. Photo: Jean Pierre Niptik

Social Systems

The Livelihood Improvement through Facilitated Extension (LIFE) model of improved extension, based on a Landcare approach, was developed through research in the Philippines. It rapidly enhanced agricultural livelihoods by improving farmer-based learning networks and community social capital. Dr Mary Johnson of RMIT University, in partnership with Filipino collaborators, will contribute to understanding the adaptability and adoptability of the Landcare–LIFE combination by trialling the LIFE model for livelihood improvement within a Fijian smallholder farmer context. The project will broker an escalation of the Landcare approach to deliver sustainable land management outcomes with government and civic partners. In 2022–23, the project team will visit Fiji to conduct a review and implement capacity building activities with community-based research staff. The project will also focus on developing the research partnership between the Philippines, Fiji and Australia.[31]

The agriculture sector has been identified as a sector for growth to support economic development and poverty alleviation in Fiji and Tonga. Livelihoods and landscapes in these countries are highly interconnected, so the populations are acutely vulnerable to the impacts of climate change and variability as well as the impacts of policy-driven intervention. With a vision of climate-smart landscapes, Dr Eleanor Bruce of the University of Sydney and Dr Bryan Boruff of the University of Western Australia lead a team to develop a collaborative geospatial platform that will identify responses to climate-smart landscape adaptation. In the project's final year, researchers will evaluate the effectiveness of the platform for promoting community and multi-stakeholder exchange and engagement with landscape knowledge. The project will also identify adaptation objectives for communities within the landscape to foster climate resilience and enhance environmental livelihood security.[32]

Integrated 'Reef to Ridge' management means protecting and sustainably utilising connected environments to promote co-benefits of biodiversity and natural and cultural resources. Dr Cherise Addinsall of Southern Cross University will lead a new project, working with Vanuatuan communities in developing 'Community Conservation Area' agreements between communities and the government to establish sustainable agricultural livelihoods alongside existing formalised land tenure and conservation goals. The project also aims to investigate models of inclusive and evidence-informed decision-making processes under climate change. In 2022–23 the project will be engaged in partnership building with local communities, government bodies and potential scaling institutions.[33]

Family Farm Teams is a peer education model of agricultural extension that has benefited the economic development of women smallholders in 9 areas of Papua New Guinea. Dr Deborah Hill of the University of Canberra leads a project to improve agricultural development opportunities for women smallholders in rural Solomon Islands. The project will investigate the adaptability of the Family Farm Teams approach in Solomon Islands, and provide comparative learning to apply it to other Pacific island countries to help communities move from semi-subsistence to planned farming in a gender-equitable way. In 2022–23, researchers will continue adapting the Family Farm Teams manual and identify individuals to undertake Family Farm Teams training and other capacity building activities. These peer educators will deliver training modules for participating smallholder men and women.[34]

Soil and Land Management

Agriculture in the Pacific region is generally confined to smallholder farms and household gardens. Its sustainability is threatened by nutrient imbalances, erosion, declining soil fertility and soil carbon loss, and climate change. A new project in 2023 expands on previous research to build farming systems resilience in Fiji, Samoa, Tonga and Vanuatu. Led by Dr Ben Macdonald of CSIRO, the project will address knowledge gaps in understanding soil organic carbon and crop nutrition management and develop the next generation of agronomic advisors and appropriate networks for collaboration. The project will continue the development and extend the reach of the Pacific Soils Portal. Researchers will introduce cost-effective technologies for rapid soil and plant analysis and real-time data capture to agricultural extension services. The project seeks to improve linkages along the export value chain by developing information pathways between the grower, extension agent and exporter, focusing on soil nutrient and carbon management.[35]

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See page 186 for contact details.

Current and proposed projects

1. Defining priority commercialisation pathways and potential private commercialisation partners for viable long-term commercialisation of products emerging from FST/2019/128 [Fiji] (AGB/2021/172)
2. Pacific Agribusiness Research in Development Initiative Phase 2 (PARDI 2) [Fiji, Tonga, Vanuatu] (AGB/2014/057)
3. Landscape and opportunity analysis in the Pacific tuna sector: Foundation analysis to identify innovation pathways to enhance participation by the Pacific community and value retention in the region [South Pacific general] (AGB/2021/173)
4. Supporting greenhouse gas inventories and livestock data development in Fiji (CLIM/2021/160)
5. Institutional barriers to climate finance through a gendered lens in Fiji, Samoa and Solomon Islands (CLIM/2021/110)
6. Transformation pathways for Pacific coastal food systems [Kiribati, Solomon Islands] (CLIM/2020/178)
7. Sustainable intensification for climate-resilient development in Pacific island countries [Samoa, Tonga] (CLIM/2020/186)
8. Finding a genetic basis for oil palm responses to basal stem rot in a long-term infected block [Papua New Guinea, Solomon Islands] (CROP/2021/130)
9. Half-pearl industry development in Tonga and Vietnam (FIS/2016/126)
10. Towards more profitable and sustainable mabé pearl and shell-based livelihoods in the western Pacific [Fiji, Papua New Guinea, Samoa, Tonga] (FIS/2019/122)
11. Improving nutrition through women's and men's engagement across the seaweed food chain in Kiribati and Samoa (FIS/2019/125)
12. Agriculture and fisheries for improved nutrition: integrated agri-food system analyses for the Pacific region [Kiribati, Solomon Islands, South Pacific general, Vanuatu] (FIS/2018/155)
13. Coalitions for change in sustainable national community-based fisheries management programs in the Pacific [Kiribati, Solomon Islands, South Pacific general, Vanuatu] (FIS/2020/172)
14. Spatially integrated approach to support a portfolio of livelihoods [Solomon Islands, South Pacific general] (FIS/2020/111)
15. Innovating fish-based livelihoods in the community economies of Timor-Leste and Solomon Islands (FIS/2019/124)
16. Coconut and other non-traditional forest resources for the manufacture of engineered wood products [Fiji] (FST/2019/128)
17. Kava land use changes [Fiji, Vanuatu] (FST/2021/146)
18. Livelihoods in forest ecosystem recovery [Solomon Islands] (FST/2020/135)
19. Understanding school food provision in the Pacific: Scoping the potential of local food systems to improve diets, nutrition and livelihoods [Fiji] (HORT/2021/159)
20. Responding to emerging pest and disease threats to horticulture in the Pacific Islands [Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga] (HORT/2016/185)
21. Safeguarding and deploying coconut diversity for improving livelihoods in the Pacific islands [Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu] (HORT/2017/025)
22. Adopting a gender-inclusive participatory approach to reducing horticultural food loss in the Pacific [Fiji, Samoa, Solomon Islands, Tonga] (CS/2020/191)
23. Improving root crop resilience and biosecurity in Pacific island countries and Australia [Fiji, Samoa, Solomon Islands, Tonga] (HORT/2018/195)
24. Aligning genetic resources, production and post-harvest systems to market opportunities for Pacific island and Australian cocoa [Fiji, Samoa, Solomon Islands, Vanuatu] (HORT/2014/078)
25. PICfood: Driving vegetable food environments to promote healthy diets in Pacific island countries [Fiji, Samoa] (HORT/2021/141)
26. Enhanced fruit systems for Tonga and Samoa (Phase 2): Community based citrus production (HORT/2019/165)
27. Increasing the productivity and profitability of smallholder beekeeping enterprises in Papua New Guinea and Fiji (LS/2014/042)
28. Improving small ruminant production and supply in Fiji and Samoa (LS/2017/033)
29. A farm planning approach to increase productivity and profitability of smallholder cattle systems in Vanuatu (LS/2018/185)
30. Development of a third party verified voluntary sustainable certification program for beef and other key commodities in Vanuatu (LS/2020/155)
31. Climate-smart landscapes for promoting sustainability of Pacific Island agricultural systems (ASEM/2016/101)
32. Landcare - an agricultural extension and community development model at district and national scale in Fiji (SSS/2019/140)
33. Climate-smart coastal landscapes for sustaining fisheries-based livelihoods and food security in the Pacific [Fiji, Tonga] (SSS/2021/120)
34. Improving agricultural development opportunities for female smallholders in rural Solomon Islands (SSS/2018/136)
35. Soil management in Pacific island countries Phase 2: Investigating nutrient dynamics and the utility of soil information for better soil and crop management [Fiji, Samoa, Tonga, Vanuatu] (SLAM/2020/139)

Papua New Guinea

A$6.79 million
Budgeted funding

16
Bilateral and regional research projects

6
Small projects and research activities

Papua New Guinea's economy is made up of 2 main industries: the labour-intensive agriculture, fisheries and forestry sectors, and the mineral and energy extraction sector, which accounts for most of the country's export earnings.

The agriculture, fisheries and forestry sectors are incredibly diverse, from remote subsistence crop production in the highlands to emerging freshwater aquaculture systems to commercially oriented export crops such as cocoa and coffee. These mixed subsistence and market systems support the livelihoods of more than 6.8 million people (85% of the population of Papua New Guinea). This immense diversity of livelihood systems brings significant challenges for Papua New Guinea policymakers, including limited infrastructure for delivering inputs and products to markets, high rates of inadequate nutrition, vulnerability to weather variability and climate change, and widespread lack of off-farm employment for youth. On-farm productivity is consequently and typically low. Improving returns from agriculture, fisheries and forestry and strengthening food nutritional security remain critical to improving the livelihoods of the majority of households in Papua New Guinea.

Direction for development for the country is currently provided by the Papua New Guinea Vision 2050, Papua New Guinea Development Strategic Plan 2010–2030 and 4 Medium Term Development Plans. The government emphasises that by 2050, renewable sectors including agriculture, fisheries and forestry, must account for 70% of GDP compared with the current 26%. Complementing these plans, the Papua New Guinea National Food Security Policy 2018–2027 guides resources to build sustainable food security for all Papua New Guineans. A primary aim of the policy is to foster strong public–private partnerships and leverage agriculture's potential to promote enhanced nutrition and health by bringing together profitable smallholder farming, efficient food value chains, women's income and child nutrition. Of particular interest to ACIAR is the PNG Agriculture Medium Term Development Plan, which lapses this year. This plan defines the specific areas for investment in agriculture.

Over the past 40 years, ACIAR has supported projects throughout Papua New Guinea across its diversity of the rural livelihoods systems. While we continue to work across the country, areas of particular focus are the the Autonomous Region of Bougainville and the Western Province. Through the South Fly Resilience Plan, Australia is looking to assist communities in the South Fly District to transition out of food insecurity and develop resilient, sustainable livelihoods and inclusive governance.

Country priorities

ACIAR research partnerships with Papua New Guinea will continue to focus on horticulture, livestock, fisheries, forestry and socioeconomics. Ultimately, the research is working to secure improvements in food supply, food access and rural incomes for smallholders through increased productivity and enhanced access to markets and services.

Research partnerships aim to:

- overcome social, cultural and policy obstacles to benefits from agricultural technologies, particularly with respect to gender equity and women
- improve smallholder vegetables and starchy staple systems
- analyse commodity and market chains to guide policy and improve production and marketing for cocoa, coffee, coconut and oil palm crops
- enhance germplasm quality for high-value tree species to improve community forestry and agroforestry systems
- work with private sector partners and farmers to adopt promising agricultural technologies
- monitor and identify options for managing biosecurity threats
- enhance livelihoods from smallholder fisheries, and inland and marine aquaculture
- increase household income through diversifying enterprises.

In 2022–23, ACIAR will refresh its partnership with Papua New Guinea establishing a long-term intent to underpin both research and capacity building collaboration. ACIAR will continue to support partner institutions to build the capacity of research personnel through long-term and short-term courses, informal networking events and hands-on experience at the project level. Through this process, we play a very significant role in contributing to the human capital of Papua New Guinea to develop skills and knowledge in sustainable agriculture, fisheries and forestry.

As women make up more than 50% of the labour force engaged in agriculture and 35% of women are actively involved in economic agriculture, gender equity will remain integral to all our projects in Papua New Guinea. Women in rural communities play a significant role in subsistence food production, household food nutritional security and agricultural value chains.

2022–23 research program

- **22 ACIAR-supported projects in Papua New Guinea**
- **16 projects are specific to this country**
- **6 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Papua New Guinea. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Crops

Basal stem rot is a fungal disease that kills oil palm in plantations across South-East Asia and the Pacific region. Growers have limited options to manage the disease. New trees are planted after the death of the infected trees but experience suggests that the incidence of the fungus seems to increase with each successive planting. Removing infected dead trees may reduce inoculum pressure but is costly and the benefit has not been demonstrated. A new research activity in 2022, led by Dr Agnieszka Mudge of the University of Queensland, will continue monthly monitoring of an experimental plot established 11 years ago. Data will be analysed to determine if infection dynamics and impact differ between genetically characterised families of trees and if there is a difference between lots where infected stem bases and roots of dead trees are removed compared with plot where they are left in place.[1]

Fisheries

Mabé (half-pearl) jewellery and shell handicraft industries provide income opportunities for coastal communities and women's social enterprises in the western Pacific. Previous projects have increased communities' technical skills of communities in producing juvenile oysters, farming mabé shell in Fiji and Tonga, and producing shell-based jewellery in Papua New Guinea. The development of greater technical capacity and a better understanding of gendered preferences and aspirations sets the basis for a new project in Fiji, Tonga, Papua New Guinea and Samoa, led by Professor Paul Southgate of the University of the Sunshine Coast. Country-specific interventions are required to ensure uniform mabé pearl jewellery/ shellcraft production protocols and standards, improve capacity for sector governance within partner institutions and stakeholders, develop marketing strategies and ensure optimal benefits flow to both women and men across the value chains.[2]

For 10 years, ACIAR and the National Fisheries Authority of Papua New Guinea have co-invested in R&D for inland fish aquaculture. Research has focused on increasing the production efficiency of small-scale fish ponds (for tilapia) integrated into household gardens and helping the National Fisheries Authority improve the production capacity of fingerlings at its central hatchery. To aid dissemination and adoption of best-practice techniques and technologies, Associate Professor Jesmond Sammut of the University of New South Wales leads a new 5-year project. The project will support the National Fisheries Authority to develop commercial tilapia businesses in peri-urban areas and reservoirs, and support villages in remote regions to gain access to reliable and affordable farming inputs and culturally appropriate training services.[3]

The Western province is the largest province in Papua New Guinea. It encompasses great regional diversity in place-based economies, cultures and ecologies. After decades of development support, the Western province remains one of the poorest regions in the world. Development interventions to date have been based largely on a deficit approach that identifies the needs and problems to be addressed and offers solutions. A small research activity led by Associate Professor Katharine McKinnon of the University of Canberra offers an alternative, strengths-based approach, building on the strengths and assets of individuals, communities and places as a starting point for thinking collectively about solutions. The study funded by DFAT aims to identify locally appropriate, strength-based livelihood development practices for the agricultural development sector working across the diverse regions of Western province. It will foster a community of practice among development practitioners working in the region to support new approaches.[4]

A small research activity funded by DFAT is led by Professor Katherine Gibson of Western Sydney University. It seeks to draw on the lessons learned from the decades of development work in the Western province. It will take a strengths-based approach by building a deeper understanding of local people's current economic (largely artisanal) activities and their diverse livelihood assets across broad geographic and cultural contexts. This new knowledge will allow development practitioners and donors to identify the foundational building blocks (strengths and assets) underpinning people's current artisanal activities that future investments can build upon. The primary objective is to map (conceptually and geographically) the place-based strengths and assets of Western Province, thus producing a knowledge base to inform agricultural resilience-building strategies.[5]

Women from Kaviananga village, along the Fly River in Western Province, sell fish at a local market. Market access is a major challenge for communities living along the Fly River. Photo: Aaron English

Forestry

In East New Britain Province, Papua New Guinea, an earlier project focused on value-added processing and developing markets for galip nuts produced by the *Canarium* or galip tree. The project, led by Professor Helen Wallace of Griffith University, provided market research, technical advice, capacity building, business mentoring and access to infrastructure for private and public sector stakeholders. Phase 2 of the project will foster private sector-led development of the galip nut industry, increase value-chain efficiency and establish commercially viable business prospects for private sector investment. In 2022–23 the project will deliver training for 300 women in key processes of the galip value chain and pilot decentralised systems for galip nut initial processing, purchasing, consolidation and collection.[6]

Improved germplasm and smallholder-friendly silvicultural systems for teak (Papua New Guinea) and sandalwood (Papua New Guinea and Cape York Peninsula) were successfully developed in an earlier project led by Dr Tony Page of the University of the Sunshine Coast. However, the complexity of cultural, social and land tenure systems in Indigenous communities can be a significant obstacle for investment in the planted forestry sector. A follow-on project starts in 2022 and aims to scale out the smallholder forest estate to the point where supporting services like nurseries and contract harvesting can be sustained, leading to an increase in planted area, wood supply and smallholder incomes. Key research questions address social and legal structures to facilitate planting on customary land to allow larger, more commercial woodlots.[7]

A project in the Eastern Highlands province, the Ramu and Markham valleys and the Lae region of Papua New Guinea aims to improve rural livelihoods through family-focused community reforestation and ecoforestry in community-owned natural forests. Led by Associate Professor Grahame Applegate of the University of the Sunshine Coast, the project has implemented family-focused community reforestation activities, identified methods for scaling out community-based reforestation and reviewed institutional arrangements and policies that improve access to formal timber markets. The project concludes in 2022 with the delivery of a proposed improved ecoforestry management system for inclusion in national policy and alternative marketing and financial models to evaluate harvesting and marketing operations of small-scale, clan-based operators.[8]

Horticulture

High-value vegetable crops are essential to improving livelihoods in the Pacific region and Cambodia. Extension services are not well equipped to assist farmers in dealing with pests and diseases, with insufficient staff training resulting in crop losses of up to 30–40%, primarily due to pests and diseases. Plant health clinics offer a solution to this problem. A new project led by Dr Michael Furlong of the University of Queensland will establish an effective information system supported by research on key emerging pests in these regions to better prepare farmers to detect, respond to and continue to manage their farming businesses, all the while contributing to regional biosecurity preparedness.[9]

Improved germplasm and silvicultural systems for teak production, developed in an earlier ACIAR project, will underpin a new project aiming to scale out the smallholder forest estate.

Developing safe, high-value fruit and vegetable industries is a priority for many Pacific island countries. Dr Michael Furlong of the University of Queensland leads a project to develop integrated pest and disease management strategies for the sustainable intensification of fruit and vegetable crop production, addressing the threats posed by the inappropriate use of pesticides, emerging pests and diseases and climate change. During 2022–23, the project will focus on providing technical training for extension staff and conducting in-country plant health clinics and pesticide awareness workshops. The project will continue to build surveillance and diagnostic capacity for managing emerging pests and diseases, including fall armyworm. The project will generate new knowledge, resources and opportunities to encourage the adoption of integrated management strategies.[10]

Coconuts contribute, directly and indirectly, to the livelihoods of coastal communities throughout the Pacific region. Much of the coconut resource in the Pacific region is ageing or already senile and unproductive. A project led by Dr Carmel Pilotti of SPC aims to support the first step in rejuvenating coconut-based livelihoods in the Pacific islands by strengthening the conservation and use of genetic diversity in coconuts, addressing threats posed by the rhinoceros beetle and Bogia coconut syndrome, and establishing and sustaining a platform for coordinating coconut research-for-development initiatives. In 2022–23 researchers will focus on training staff in field transfer of plantlets derived from embryo culture and identifying key varieties for preservation in the new cryopreservation facility that will be built and commissioned.[11]

Cocoa production directly supports about two-thirds of the population of the Autonomous Region of Bougainville. Many cocoa farmers have formed cohesive communities with clear goals and objectives, which include assistance to improve crop profitability. Professor David Guest of the University of Sydney leads a project to improve the productivity, profitability and vitality of smallholder cocoa farming families and communities. During the project's final year, researchers will focus on completing village gardens and nurseries, evaluating soil quality, and finalising the establishment of support networks, research hubs and farmer training for cocoa production and other potential enterprises.[12]

Coffee production in Papua New Guinea provides employment for more than 2.5 million people and is a major source of income for approximately 400,000 smallholder farmers. The most serious pest of coffee globally, the coffee berry borer, is a recent incursion to highland coffee production areas. The pest is a major threat to the livelihoods of rural families and their communities and a significant threat to biosecurity in Australia. Dr Ian Newton of the Queensland Department of Agriculture and Fisheries leads a project to limit damage and introduce world-best crop protection practices. During 2022–23, activities will include evaluation and updating of a best-practice integrated pest management (IPM) package and testing of biological and chemical control solutions.[13]

Livestock Systems

Strong domestic demand for honey and the potential to export honey and its by-products offers an opportunity to smallholder farmers in Fiji and Papua New Guinea. A project, led by Dr Cooper Schouten of Southern Cross University, aims to increase the productivity and profitability of beekeeping enterprises to complement smallholder incomes and promote an income-earning activity for women. During 2022–23, the project will continue to develop best-practice pest and disease management programs, particularly in readiness for incursions of varroa and tropilaelaps mites. Development of post-harvest quality management programs for producers and packers will continue, for standards, certification and testing processes for export grade honey. The project will also provide capacity building opportunities for beekeeping associations to support smallholder industry development.[14]

Tuberculosis is a leading cause of death in Papua New Guinea, and a leading cause of death from infectious diseases worldwide. In addition to pulmonary tuberculosis, there is a high burden of suspected extrapulmonary tuberculosis in the Pacific region, which requires different approaches to management and prevention. Dr Philipp Du Cross of the Burnet Institute is conducting a small research activity to determine the types of bacteria causing tuberculous lymphadenitis, with a focus on risk factors associated with exposure to animals. The study aims to define the proportion of clinically diagnosed tuberculosis lymphadenitis that is attributable to drug-sensitive and drug-resistant *Mycobacterium* spp. The results will be important for the development of clinical and program management of tuberculosis.[15]

Dr Julianne Biddle (ACIAR) and Quang Nguyen (PhD candidate, University of Queensland) inspect coconut varieties grown through somatic embryogenesis in the microbiological and plant containment facility at Gatton Campus (HORT/2017/025) Photo: Andrew Sillis

Japanese encephalitis is one of the most important causes of viral encephalitis in humans in South-East Asia. In Papua New Guinea, the disease primarily affects rural communities, with the highest rates of disease occurring in children. Although an effective vaccine is available, more than 100,000 cases occur annually, and Japanese encephalitis remains a potentially important zoonotic risk for the PNG population. A small research activity, led by Dr David Williams of CSIRO, brings together partners with a strong track record in human, animal and vector surveillance and aims to consolidate and build on the previous research activity to expand a One Health surveillance approach for Japanese encephalitis and other arthropod-borne viruses in Papua New Guinea.[16]

Social Systems

Coffee is economically important for rural livelihoods in Papua New Guinea. Despite a rapidly growing population in the highland coffee-growing areas, national production is declining. A project led by Professor George Curry of Curtin University aims to increase returns for labour from the crop, particularly for women, through the adoption of culturally acceptable and nutrient-efficient coffee–vegetable intercropping systems. In the project's final year, researchers will hold meetings in participating villages outlining the results of the trials and the potential benefits for farmer families and industry.[17]

Communities reliant on agriculture-based livelihood systems in Papua New Guinea are particularly at risk from climate variability and change. Dr Steven Crimp of the Australian National University leads a project examining ways in which seasonal climate information, with a 3 to 6-month lead time, can be communicated and integrated with existing farm practices. The aim is to increase the adaptive capacity of farmers, to help them reduce risk and secure adaptive opportunities for food production. During 2022–23, activities focused on field sites will continue to demonstrate the potential value of integrating scientific and Indigenous knowledge. Results from the first-round field trials will be analysed and used to inform the design of second-round trials.[18]

The successful Family Farm Teams approach will be adapted and applied to develop the capacity of religious institutions in Papua New Guinea to work in a gender-inclusive way when engaging rural agricultural communities in smallholder farm development. The project led by Dr Josephine Caffery of the University of Canberra will also provide pathways for increasing youth involvement in family farm teams and sustainable farming futures. In 2022–23 the project team will deliver activities to build the capacity of youth change agents while developing Family Farm Teams resources specifically for young people.[19]

Soil and Land Management

In Papua New Guinea, sweetpotato is being grown with a shorter fallow period, more rotations with alternative crops and shorter cropping periods to cope with increasing population pressure. Sustainable intensification of production is needed. A project led by Professor Neal Menzies of the University of Queensland focuses on addressing soil fertility decline with smallholder farmers with the aim of improving yields and increasing household income through sweetpotato production. Concluding in 2023, the project will determine the optimum rates of mineral fertilisers and opportunities to use organic nutrient sources to avoid soil fertility decline, increase production, and improve the benefit:cost ratio of inputs.[20]

Papua New Guinea's Vision 2050 requires the contribution of renewable sectors, including agriculture, fisheries and forestry, to GDP to increase from 26% to 70%. A new project, led by Mr Peter Wilson and Dr Mark Thomas of CSIRO, will provide useful and targeted information about the natural resource base in support of agriculture, forestry and infrastructure planning, development and management. The project will modernise the Papua New Guinea Resources Information Systems that was developed in the 1980s and 1990s. It will deliver a technologically advanced, well-managed soil information system that adheres to FAIR (findable, accessible, interoperable, reusable) data principles and provides valuable information to key decision-makers and a range of stakeholders in the agriculture and forestry sectors.[21]

The successful Family Farm Training model has been adpated to empower youth, especially females, to ensure they become an integral part of the family farming team. Pictured are youths in East New Britain, learning how to budget their funds. Photo: Aaron English

The first stage of a cocoa farming systems project in Papua New Guinea demonstrated that yields can be increased with improved soil management and better soil fertility, lifting incomes and improving the livelihoods of smallholder cocoa farming households. A project led by Professor Damien Field of the University of Sydney will build on the outputs and outcomes of the first phase of research. The project will evaluate opportunities to develop site-specific solutions to improve cocoa farming systems using locally available resources to address soil constraints and improve the soil health and productivity of cocoa plantations. In 2022–23, activities include training a cohort of local staff as mentors for smallholder farmers, assessing a family farm teams approach to learning about soil management and studying the influence of composts and crop diversification on soil and plant health and the quality of cocoa.[22]

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Horticulture: Ms Irene Kernot
Livestock Systems: Dr Anna Okello
Social Systems: Dr Clemens Grünbühel
Soil and Land Management: Dr James Quilty

See page 186 for contact details.

Current and proposed projects

1. Finding a genetic basis for oil palm responses to basal stem rot in a long-term infected block [Papua New Guinea, Solomon Islands] (CROP/2021/130)
2. Towards more profitable and sustainable mabé pearl and shell-based livelihoods in the western Pacific [Fiji, Papua New Guinea, Samoa, Tonga] (FIS/2019/122)
3. Improving peri-urban and remote inland fish farming in Papua New Guinea to benefit both community-based and commercial operators (FIS/2018/154)
4. Strengthening agricultural resilience in Western Province: Developing methods for strengths-based livelihoods approach [Papua New Guinea] (FIS/2021/113)
5. Strengthening agricultural resilience in Western Province: Mapping place-based strengths and assets [Papua New Guinea] (FIS/2021/122)
6. Enhancing private sector-led development of the canarium industry in Papua New Guinea - phase 2 (FST/2017/038)
7. Promoting smallholder teak and sandalwood plantations in Papua New Guinea and Australia (FST/2018/178)
8. Enabling community forestry in Papua New Guinea (FST/2016/153)
9. Biosecurity planning [Cambodia, Papua New Guinea] (HORT/2021/151)
10. Responding to emerging pest and disease threats to horticulture in the Pacific Islands [Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga] (HORT/2016/185)
11. Safeguarding and deploying coconut diversity for improving livelihoods in the Pacific islands [Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu] (HORT/2017/025)
12. Developing the cocoa value chain in Bougainville [Papua New Guinea] (HORT/2014/094)
13. Protecting the coffee industry from coffee berry borer in Papua New Guinea and Australia (HORT/2018/194)
14. Increasing the productivity and profitability of smallholder beekeeping enterprises in Papua New Guinea and Fiji (LS/2014/042)
15. Drug sensitive and resistant tuberculosis and zoonotic infections as causes of lymphadenitis in 3 provinces in Papua New Guinea (LS/2018/217)
16. Strengthened surveillance for vector-borne zoonotic and livestock diseases in Papua New Guinea (LS/2021/158)
17. Improving livelihoods of smallholder coffee communities in Papua New Guinea (ASEM/2016/100)
18. Climate-smart agriculture opportunities for enhanced food production in Papua New Guinea (ASEM/2017/026)
19. Gender equitable agricultural extension through institutions and youth engagement in Papua New Guinea (SSS/2018/137)
20. Sustaining soil fertility in support of intensification of sweetpotato cropping systems [Papua New Guinea] (SMCN/2012/105)
21. Better soil information for improving PNG's agricultural production and land use planning: Building on PNGRIS and linking to the Pacific Regional Soil Partnership [Papua New Guinea] (SLAM/2019/106)
22. Optimising soil management and health in Papua New Guinea integrated cocoa farming systems - Phase 2 (SLAM/2019/109)

5.2

East and South-East Asia

Photo: Chris Maglangit

East and South-East Asia

Collectively, the countries of East and South-East Asia are the most populous in the world and an economic powerhouse. Ten of these countries are members of the Association of Southeast Asian Nations (ASEAN) and engage closely in terms of trade and investment with east Asian countries, including China and South Korea.

Before the COVID-19 pandemic, ASEAN economies were forecast to have some of the highest growth rates in the world over the next 5 years. The IMF and OECD had forecast an average of 5% growth per annum, a higher rate than some of the more developed economies of Europe and North America. The ASEAN economy has consistently outperformed the global economy and is the fifth largest economy in the world, with a combined GDP of A$4.8 trillion in 2018.

As a result of the pandemic, 4.7 million people in South-East Asia were living in extreme poverty in 2021. According to a new Asian Development Bank report presented at the Southeast Asia Development Symposium, 9.3 million jobs disappeared, the region's GDP shrank by 3.3% and foreign direct investment inflows declined by 33.2%.

Throughout 2020, the number of cases and death rate due to COVID-19 were relatively low in ASEAN countries. However, during 2021, the region experienced substantially higher rates of COVID-19 infection, hindering recovery and economic growth. With only 59% of the region's population fully vaccinated (as of February 2022), there remains a major risk of widespread unemployment, worsening inequality, and rising poverty levels, especially among women, youth and the elderly, in South-East Asia.

With more than 100 million hectares of agricultural land, the ASEAN countries collectively are a major producer, supplier and exporter of various crops, grains (including rice) and livestock products. Although agriculture only contributes around 10% of total ASEAN GDP, it is the main sector for employment in most member states, accounting for approximately one-third of total ASEAN employment. Given its significant role, the development of the food, agriculture and forestry sectors in ASEAN countries is vital to ensuring equitable and inclusive growth in the region.

The COVID-19 pandemic exposed the vulnerabilities of food supply chains in the region, prompting calls for the region to become food resilient and sustainable by shortening existing food supply chains and strengthening food systems. The pandemic also heightened the pressure on countries to reverse the trend of underinvesting in the food and agriculture sector. This includes investing in rural logistics, upskilling, research and development, in addition to harnessing the use of digital technology to benefit the farming community.

Food security, food safety and better nutrition remain priority concerns within the region. These priorities align with ASEAN's goals of agricultural cooperation. Support for women's economic empowerment, which has become a prominent approach to addressing gender gaps in economic spheres, including agriculture, continues to grow.

Partner countries in the ACIAR East and South-East Asia region

- Cambodia
- China
- Indonesia
- Laos
- Malaysia
- Myanmar
- Philippines
- Thailand
- Timor-Leste
- Vietnam

Drivers of regional collaboration

The principal driver of regional collaboration in the East and South-East Asia region is the ASEAN, which for more than 50 years has addressed shared challenges and engaged trade and development partners, including Australia and China. Recently, regional collaboration has been driven by critical factors such as the COVID-19 pandemic, geopolitics, and transboundary concerns.

Trade and investment are the major drivers of economic growth in the region, aided by overseas development assistance. The ASEAN-led Regional Comprehensive Economic Partnership (RCEP) Agreement came into force in January 2022 and is expected to help strengthen regional economic integration and provide access to a larger market, which will assist the post-pandemic recovery of the ASEAN economies.

In the agricultural research sector, ACIAR is supporting regional collaboration through support to Asia–Pacific Association of Agricultural Research Institutions (APAARI). Cross-border challenges such as plant and animal biosecurity remain prominent and also drive regional integration. In the Mekong region, plant diseases have recently spread across borders, destroying crops of cassava and banana. African swine fever has taken a tremendous economic toll on countries such as Vietnam, the Philippines, Laos and Cambodia. The COVID-19 pandemic has raised biosecurity and One Health (the interface between human, animal and environmental health) as priorities in the region.

Shared concerns about imminent and increasing threats posed by climate change have resulted in ASEAN creating a 'framework of ASEAN community building, with strategies and actions to enhance regional and international cooperation in supporting adaptation'. In the field of agricultural research and development, regional cooperation plays a significant role, particularly regarding increasing resilience and adaptation to climate change, natural disasters and other shocks.

The South-East Asia region is one of the most natural disaster-prone in the world. Natural disasters threaten food security and rural livelihoods and have economic consequences for the whole region, so disaster mitigation is a common interest among neighbouring countries. The ASEAN Declaration on 'One ASEAN, One Response' aims to increase the speed, scale and solidarity of disaster response in the region.

ACIAR East and South-East Asia region program

Our program in East and South-East Asia remains the largest across the 4 regions in which ACIAR operates. The nature of our engagement within the region is strongly bilateral, based on robust partnerships with national research systems, long-standing diplomatic connections, and sustained development collaboration with Australia. However, there is a growing trend towards regional collaboration between countries facing shared challenges. This is consistent with the research partnerships under ASEAN, which acknowledge that collaboration among member states is a sensible path towards addressing common challenges in the region.

Region-wide cooperation on forest biosecurity

Our on-the-ground work in South-East Asia primarily occurs with 7 partner countries. However, we do work with development and coordinating organisations based in other countries in the region on issues and programs of regional significance.

For example, in recent decades Thailand has transitioned from aid recipient to aid donor. Thailand hosts regional organisations of relevance to ACIAR programs, including APAARI (page 20), the Asian Institute of Technology and the FAO regional office. We also include Thai expertise on projects of regional significance when opportunities arise.

In 2022–23, we have a regional project, 'Building effective forest health and biosecurity networks in South-East Asia' (FST/2020/123), that includes partners from Thailand and Malaysia, as well as partners from Cambodia, Indonesia, Laos and Vietnam. A description of this project can be found on page 93 in the Cambodia chapter.

The ASEAN drive towards regional economic integration and connectivity will increase demand from individual countries and regional bodies for research support that harmonises approaches to some agricultural issues across countries, including biosecurity, food safety and climate resilience. We contribute to this by funding regional research collaboration and through our support and chairing of APAARI.

Among our newer regional collaborations in the East and South-East Asia region are efforts to identify efficient biosecurity risk-management systems in the region to respond to prominent outbreaks affecting plant and animal health. For example, Indonesia, the Philippines and Laos are involved in regional research focusing on an integrated system to manage *Fusarium* wilt (Panama disease) in banana crops with components of biosecurity and disease management.

Another research collaboration focusing on plant biosecurity engages the whole of the Mekong region and China. The research will address serious diseases of cassava through a multipronged strategy involving breeding, surveillance, agronomy and seed systems interventions, coupled with engagement with government institutions and agribusiness.

The incursion of African swine fever to the region in 2019 also provided a strong context for regional collaboration in One Health. An ACIAR regional research collaboration that involves Cambodia, Vietnam and Laos seeks to understand how veterinary service markets might be better managed and governed by agents of government interested in human health, in cooperation with agents interested in agriculture and animal health.

During 2022–23, a series of project will be implemented throughout the region under the ACIAR–IDRC Research Program on One Health (AIRPOH). Cambodia, Indonesia, Laos, The Phillippines and Timor-Leste will host a portfolio of interconnected projects supporting research that aims to promote new ideas and thinking on the relationship and management of human, animal and environmental health (page 24).

Trilateral collaboration and new partnership models are emerging for ACIAR in the East and South-East Asia region. Driving these new partnership models are greater capacities that can be achieved when resources are pooled. This is translating into substantial co-investment from partners such as Vietnam, Indonesia and the Philippines. While bilateral relationships remain the predominant model for development cooperation in the region, trilateral collaboration is increasingly possible and desired by partner countries.

Opportunities for trilateral research collaboration with Australia in the region include varietal development to manage devastating new diseases in banana, cassava and citrus; machinery innovation for conservation agriculture among smallholder farmers; and research to develop perennial rice varieties.

Securing the future of coconut

Grown in more than 90 tropical countries, on more than 12 million hectares, coconut is important to millions of smallholder households. The future of coconut production and livelihoods is threatened by senile plantings, which face further decline from pest and disease, climate change and poor conservation and management of genetic resources. Access to coconut genetic diversity is vital to sustaining the livelihoods of millions of smallholders and their communities around the world, particularly in the Asia-Pacific region.

During 2022–23, ACIAR, DFAT and the International Coconut Community will continue their collaboration to reinvigorate and sustain the Coconut Genetic Resources Network (COGENT). The program will focus on better coconut science, through a global coconut strategy to address the challenges outlined above. The program will work with other organisations to ensure a viable COGENT secretariat to safeguard coconut genetic resources and better address disease threats. The network is active throughout the Asia-Pacific region and led by Dr Jelfina Alouw, Executive Director of the International Coconut Community, who is based in Jakarta, Indonesia.

ACIAR project GP/2018/193

East and South-East Asia region program 2022–23

Partner country	No. projects
Cambodia	17
Indonesia	20
Laos	19
Myanmar	3
Philippines	11
Timor-Leste	5
Vietnam	24

Note that a project may be conducted in several countries, therefore the total number of projects in this table will be greater than the number of projects in the region.

75 projects

58 research projects

17 small research activities

This data was compiled in August 2022. Additional projects may be commissioned during 2022–23.

Research portfolio

12 Agribusiness projects

3 Climate Change projects

3 Crops projects

13 Fisheries projects

6 Forestry projects

8 Horticulture projects

11 Livestock Systems projects

7 Social Systems projects

11 Soil and Land Management projects

1 Water project

Table 5.2 **Current and proposed projects in the East and South-East Asia region, 2022–23**

Project title	Project code	Country
Agribusiness		
Agricultural policy research to support natural resource management in Indonesia's upland landscapes	ADP/2015/043	Indonesia
Understanding the drivers of successful and inclusive rural regional transformation: Sharing experiences and policy advice in Bangladesh, China, Indonesia and Pakistan	ADP/2017/024	Bangladesh, China, Indonesia, Pakistan
Inclusive agriculture value chain financing	AGB/2016/163	Indonesia, Myanmar, Vietnam
Establishing sustainable solutions to cassava diseases in mainland South-East Asia	AGB/2018/172	Cambodia, Laos, Myanmar, Vietnam
Increasing the sustainability, productivity and economic value of coffee and black pepper farming systems and value chains in the Central Highlands Region of Vietnam	AGB/2018/175	Vietnam
Agribusiness-led inclusive value chain development for smallholder farming systems in the Philippines	AGB/2018/196	Philippines
Planning and establishing a sustainable smallholder rice chain in the Mekong Delta	AGB/2019/153	Vietnam
Integrating smallholder households and farm production systems into commercial beef supply chains in Vietnam	AGB/2020/189	Vietnam
Evaluating supply chain interventions and partnerships to sustainably grow the smallholder dairy sectors of Indonesia and the Philippines	AGB/2021/124	Indonesia, Philippines
Creating resilient communities through smallholder-inclusive tourism markets in Indonesia	AGB/2021/125	Indonesia
Piloting digital monitoring of VietGAP compliance and quality in Vietnam vegetable value chains	AGB/2021/153	Vietnam
Food loss in the *Pangasius* catfish value chain of the Mekong River Basin (Food Loss Program)	CS/2020/209	Cambodia, Laos, Vietnam
Climate Change		
Supporting greenhouse gas inventories and targeted rice mitigation options for Vietnam	CLIM/2019/150	Vietnam
Preparing for mangrove-based climate and agribusiness transformation in the Mekong Delta	CLIM/2021/138	Vietnam
Supporting the tracking sharing learning platform of the Adaptation Research Alliance	CLIM/2022/108	Global
Crops		
International Mungbean Improvement Network 2	CROP/2019/144	Bangladesh, India, Indonesia, Kenya, Myanmar
Weed management techniques for mechanised and broadcast lowland crop production systems in Cambodia and Laos	CROP/2019/145	Cambodia, Laos
Agricultural Innovations for Communities: Intensified and diverse farming systems for Timor-Leste (AI-Comm 2)	CROP/2021/131	Timor-Leste
Fisheries		
Harvest strategies for Indonesian tropical tuna fisheries to increase sustainable benefits	FIS/2016/116	Indonesia
Increasing technical skills supporting community-based sea cucumber production in Vietnam and the Philippines	FIS/2016/122	Philippines, Vietnam
Half-pearl industry development in Tonga and Vietnam	FIS/2016/126	Tonga, Vietnam
Assessing upstream fish migration measures at Xayaburi Dam in Laos	FIS/2017/017	Laos
A nutrition-sensitive approach to fisheries management and development in Timor-Leste and Nusa Tenggara Timur Province, Indonesia	FIS/2017/032	Indonesia, Timor-Leste
Baseline monitoring and evaluation of long-term impacts on fish stocks from coral restoration	FIS/2018/128	Philippines
FishTech: Integrating technical fisheries solutions into river development programs across South-East Asia	FIS/2018/153	Cambodia, Indonesia, Laos, Vietnam, Thailand

Project title	Project code	Country
Regional coral restoration networks and appropriate technologies for larger-scale coral and fish habitat restoration in the Philippines and Australia	FIS/2019/123	Philippines
Innovating fish-based livelihoods in the community economies of Timor-Leste and Solomon Islands	FIS/2019/124	Solomon Islands, Timor-Leste
Developing social and economic monitoring and evaluation systems in Indonesian tuna fisheries to assess potential impacts of alternative management measures on vulnerable communities	FIS/2020/109	Indonesia
Blue economy: Valuing the carbon sequestration potential in oyster aquaculture	FIS/2020/175	Vietnam
Institutional effectiveness and political economy of coral reef restoration in the Philippines	FIS/2021/112	Philippines
Supporting grouper-farming smallholders in Vietnam to improve their SME businesses by engaging with aquafeed companies to produce commercial feeds	FIS/2021/121	Vietnam
Forestry		
Advancing enhanced wood manufacturing industries in Laos and Australia	FST/2016/151	Laos
Managing risk in South-East Asian forest biosecurity	FST/2018/179	Indonesia, Vietnam
Building an effective forest health and biosecurity network in South-East Asia	FST/2020/123	Cambodia, Laos, Vietnam
Vietnamese native tree species for improved livelihoods	FST/2020/134	Vietnam
Forest restoration for economic outcomes	FST/2020/137	Laos
Retaining the jewels in the crown: Kalimantan peat forest remnants	FST/2021/145	Indonesia
Horticulture		
Supporting an international initiative to maintain the coconut genetic resources network (COGENT)	GP/2018/193	Indonesia
Development of area-wide management approaches for fruit flies in mango for Indonesia, Philippines, Australia and the Asia-Pacific region	HORT/2015/042	Indonesia, Philippines
Developing vegetable value chains to meet evolving market expectations in the Philippines	HORT/2016/188	Philippines
Improving mango crop management in Cambodia, the Philippines and Australia to meet market expectations	HORT/2016/190	Cambodia, Philippines
An integrated management response to the spread of *Fusarium* wilt of banana in South-East Asia	HORT/2018/192	Indonesia, Laos, Philippines
Preparedness and management of huánglóngbìng (citrus greening disease) to safeguard the future of citrus industry in Australia, China and Indonesia	HORT/2019/164	Indonesia
Safe, fresh, year-round vegetables in Cambodia and Laos through research and development support of whole supply chain agribusiness networks	HORT/2021/143	Cambodia, Laos
Biosecurity planning	HORT/2021/151	Cambodia, Papua New Guinea
Livestock Systems		
Intensification of beef cattle production in upland cropping systems in Northwest Vietnam	LPS/2015/037	Vietnam
Investigating and developing interventions to mitigate food borne parasitic disease in production animals in Laos	LS/2014/055	Laos
Goat production systems and marketing in Laos and Vietnam	LS/2017/034	Laos, Vietnam
Asian chicken genetic gains: A platform for exploring, testing, delivering, and improving chickens for enhanced livelihood outcomes in South East Asia	LS/2019/142	Cambodia, Vietnam
Global burden of animal disease initiative: Indonesia case study	LS/2020/156	Indonesia
Bacterial enteropathy and nutrition study in poultry	LS/2021/126	Timor-Leste
Rapid transformation of Lao beef sector – biosecurity, trade and smallholders	LS/2021/128	Cambodia, Laos

Project title	Project code	Country
Global animal health governance: High-level consortium	LS/2021/157	Vietnam
Developing strategies to reduce brucellosis transmission in Timor-Leste based on One Health collaboration (ACIAR–IRDC One Health Research Program)	LS/2022/161	Timor-Leste
Policy support to the Philippines' national surveillance and control programs for African swine fever, avian influenza and antimicrobial resistance: A One Health systems approach (ACIAR–IRDC One Health Research Program)	LS/2022/162	Philippines
Livestock enhancement through ecohealth/One Health assessment in South-East Asia (ACIAR–IRDC One Health Research Program)	LS/2022/163	Indonesia, Laos, Philippines
Social Systems		
Uptake of agricultural technologies amongst farmers in Battambang and Pailin provinces, Cambodia	ASEM/2013/003	Cambodia
Enhancing livelihoods through forest and landscape restoration	ASEM/2016/103	Philippines
Analysing gender transformative approaches to agricultural development with ethnic minority communities in Vietnam	SSS/2018/139	Vietnam
Next generation agricultural extension: Social relations for practice change	SSS/2019/138	Cambodia
Policy impact in Laos: From research to practice	SSS/2020/142	Laos
Building the evidence base on the impacts of mobile financial services for women and men in farming households in Laos and Cambodia	SSS/2020/160	Cambodia, Laos
The role of agricultural and forest landscapes on human and environmental health in Cambodia (ACIAR–IRDC One Health Research Program)	SSS/2022/164	Cambodia
Soil and Land Management		
Improving community fire management and peatland restoration in Indonesia	FST/2016/144	Indonesia
Land management of diverse rubber-based systems in the southern Philippines	SLAM/2017/040	Philippines
Farmer options for crops under saline conditions in the Mekong River Delta, Vietnam	SLAM/2018/144	Vietnam
Crop health and nutrient management of shallot-chilli-rice cropping systems in coastal Indonesia	SLAM/2018/145	Indonesia
Managing heavy metals and soil contaminants in vegetable production to ensure food safety and environmental health in the Philippines	SLAM/2020/117	Philippines
Validating technologies for assessing and monitoring the impacts of re-wetting of peatland Indonesia using eddy flux towers coupled with the Chameleon sensors	SLAM/2020/118	Indonesia
Evaluation of livelihood zones, rural household trajectories, research and development partners and initiatives in Timor-Leste	SLAM/2021/108	Timor-Leste
Embedding knowledge and exploring future research opportunities in sloping land agricultural systems in northern Laos and Northwest Vietnam	SLAM/2021/152	Laos, Vietnam
Management practices for profitable crop livestock systems for Cambodia and Laos	SMCN/2012/075	Cambodia, Laos
Improving maize-based farming systems on sloping lands in Vietnam and Laos	SMCN/2014/049	Laos, Vietnam
Land suitability assessment and site-specific soil management for Cambodian uplands	SMCN/2016/237	Cambodia
Water		
Water for fish and irrigation in the Mekong	WAC/2021/135	Cambodia, Laos

Cambodia

A$3.66 million
Budgeted funding

14
Bilateral and regional research projects

3
Small projects and activities

In late 2021, the Kingdom of Cambodia declared it would live with COVID-19, and reopened the country to business and tourism. While health measures remain in place, Cambodia has initiated its economic recovery plan.

Cambodia has suffered critical shocks triggered by the global pandemic, and the economic impacts have been as severe as the health impacts. The GDP is however predicted to recover with growth of greater than 6% anticipated for 2023.

Poverty remains higher than pre-pandemic levels, with the lowest rate in Phnom Penh (4.2%) and the highest rate in rural areas (22.8%). About 76% of Cambodia's population lives in rural areas.

Cambodia's agricultural sector remains a key source of employment and accounted for approximately a quarter of the country's GDP in 2021. More than 60% of poverty reduction from 2007 to 2011 was attributed to positive developments in the agriculture sector and in 2020 the World Bank reported that it is the sector least affected by the global pandemic.

Recently, the Cambodian Minister of Agriculture, Forestry and Fisheries stated that 2 of the challenges Cambodia faces include the impact of severe droughts and floods, which increasingly threaten yields and incomes each year. According to the Global Climate Risk Index for 2000–2019, Cambodia ranked 14th in the world for countries most affected by climate-related extreme weather events.

Cambodia's agricultural production increased slightly in 2021, despite less favourable weather conditions. Wet season rice cultivation reached 2.6 million hectares, a 5.4% year-on-year increase. Wet season rice yield increased to 4.1 tonnes per hectare, up from 3.5 tonnes per hectare in 2020. Throughout the pandemic, the agriculture sector has benefited from increased labour availability due to layoffs in the services and industry sectors and the return of migrant workers from cities and abroad.

The Cambodia–China Free Trade Agreement came into effect in January 2022 and will likely provide a further boost to Cambodia's agricultural production and exports, especially to the Chinese market. The country's agricultural production and exports have expanded during the pandemic as demand increases.

The Ministry of Agriculture, Forestry and Fisheries is in the midst of implementing its 2019–25 Agriculture Sector Development Strategy, which aims at modernising the agriculture sector. This is an important step towards accelerating the transformation from subsistence farming to commercial agriculture.

Country priorities

ACIAR and the Royal Government of Cambodia (represented by the Ministry of Agriculture, Forestry and Fisheries) have an ongoing 10-year agreement on the strategic priorities for research collaboration. From 2019 to 2029, research collaborations will focus on 3 domains to support the development of Cambodian agriculture:

- sustainable intensification and diversification of agriculture, focusing on non-rice crops in traditional crop-rice systems and alternative cropping systems
- sustainable intensification of market-oriented smallholder livestock production systems
- sustainable intensification of freshwater aquaculture production systems for nutrition-rich species.

Research priorities over this time will also take into consideration cross-cutting themes that address challenges across the agriculture sector. These are:

- gender equity, women's empowerment and nutrition – these are particularly important in the context of increasing labour migration that impacts women and children in rural Cambodia, and high rates of stunting and poor nutrition among women and children
- climate variability mitigation and adaptation to climate change, taking into consideration climate variability and enabling climate-resilient farming systems
- food safety and standards.

2022–23 research program

- **17 ACIAR-supported projects in Cambodia**
- **4 projects are specific to this country**
- **13 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Cambodia. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Cassava witches' broom disease and Sri Lanka cassava mosaic virus are spreading rapidly in South-East Asia. A project led by Dr Jonathan Newby of the International Center for Tropical Agriculture is developing technically viable and economically and socially sustainable ways to improve the resilience of cassava production systems and value chains in Cambodia, Laos, Myanmar and Vietnam. The project will conclude in 2023 with researchers continuing on-farm testing of new agronomic practices and training of farmers and extension officers. The project team will also finalise their investigation of alternative models for public-private funding for core activities.[1]

Ms Pou Chanthea is a cassava farmer in Tboung Khmum province in central Cambodia. ACIAR-supported projects are working with farmers and agencies to identify and introduce agronomic practices and value chain management to reduce the impact of disease in cassava crops. Photo: Majken Soegaard

Catfish (*Pangasius* sp) farming and wild-caught catfish are important income generating activities for smallholder farmers in the Mekong River Basin and are a vital source of dietary protein for those countries' populations. The continued availability of catfish for human consumption is influenced by many factors including climate change, the COVID-19 pandemic, consumer perceptions on food and health safety provenance, and environmental and political changes. Dr Van Kien Nguyen of the Health and Agricultural Policy Research Institute leads a new project in Cambodia, Laos and Vietnam to identify food loss and waste along the catfish value chain; conduct foresight exercises to determine the uncertainties of catfish production for food systems; and develop solutions to reduce food loss in catfish production. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).[2]

Crops

New crop establishment practices for rice, such as broadcasting and direct seeding (manually or mechanically), offer significant labour savings for growers. However, changed field conditions compared with traditional crop establishment methods, such as transplanting, increase the risk of weed infestations. A project in Cambodia and Laos, led by Dr Jaquie Mitchell of the University of Queensland, is developing weed management packages to address labour constraints and reduce the reliance on chemical control. The project is engaging with farmer groups and their advisers to determine knowledge gaps in weed management, and identify practical solutions to develop integrated weed management packages suitable for rainfed lowland rice production systems, specific to locations.[3]

Fisheries

Floodplain development and the regulation of river flows for rice production across South-East Asia are affecting fisheries and fish migration, and the livelihoods of communities that depend on fish for protein and trade. Previous ACIAR-supported research showed that integrating fishways into water regulator designs, allowing passage of migratory fish up and down regulated rivers, can have lasting economic and social benefits for river communities. Professor Lee Baumgartner of Charles Sturt University leads a project to establish a stakeholder network to facilitate sound, cross-sector decision-making on fish passage construction programs across South-East Asia. During 2022–23, researchers will continue gathering data on fish migration and undertake an international review of draft guidelines and curriculum for a specially designed Graduate Certificate in Fisheries. An additional DFAT investment aims to broaden the projects outcomes to include scaling of fish passage technologies across Mekong countries.[4]

Forestry

Increased trade, global movement and a changing climate increase the threat of emerging pests and diseases. The capability to detect and respond to forest pest and disease incursions is crucial to minimising their impacts. In South-East Asia, this capacity varies widely, but there is a general lack of preparedness. A project co-led by Dr Madaline Healey and Associate Professor Simon Lawson of the University of the Sunshine Coast will establish an effective and sustainable forest biosecurity network to improve risk management for invasive forest pests and diseases. The project will use shared field protocols and data as an entry point and foundation for coordinated biosecurity response. In 2022–23 activities will include launching resources to assist with in-country identification of pests and pathogens and delivering biosecurity awareness training.[5]

University of Queensland researchers are working with farmer groups and their advisers to develop integrated weed management packages suitable for rainfed lowland rice production systems. Photo: Sarina McFadyen

ACIAR-funded cattle research in Cambodia and Laos since the early 2000s will be reviewed to understand its relevance and application to the rapidly changing beef sector in the Mekong region. Photo: Harry Campbell-Ross

Horticulture

Appropriate low-cost protected cropping provides an opportunity to develop inclusive economies around vegetable production using collaborative supply chains to grow and market traceable, safe, fresh vegetables. A new project led by Mr Jeremy Badgery-Parker of the University of Adelaide will address the technical and social challenges of year-round safe, reliable vegetable production through understanding the inputs and outputs of these production systems. The project will support smallholder farmers in Cambodia and Laos to be climate-resilient, sustain natural landscapes, minimise waste and emissions, and significantly increase yields leading to increased income.[6]

Mango production in the Asia-Pacific region accounts for about two-thirds of global production. Much of the crop is produced by smallholders, who achieve relatively modest yields and participate in traditional value-chain arrangements that offer little incentive to innovate or pursue higher quality. Some producers seek better returns by supplying higher-value export markets (such as Korea), but struggle to deliver fruit that meets market or regulatory standards. Dr Muhammad Sohail Mahzar of the Northern Territory Department of Primary Industry and Fisheries Industry, Tourism and Trade will lead a new project in Cambodia and the Philippines that aims to improve the ability of selected mango supply chains to deliver fruit that better meets consumer expectations of quality and value, and provide smallholder growers with a better return on investment.[7]

High-value vegetable crops are essential to improving livelihoods in the Pacific region and Cambodia. Extension services are not well equipped to assist farmers in dealing with pests and diseases, with insufficient staff training resulting in losses of up to 30–40%, primarily due to pests and diseases. Plant health clinics offer a solution to this problem. A new project led by Dr Michael Furlong of the University of Queensland will establish an effective information system supported by research on key emerging pests in these regions to better prepare farmers to detect, respond to and continue to manage their farming businesses, all the while contributing to regional biosecurity preparedness.[8]

Livestock Systems

ACIAR has funded cattle research in Cambodia and Laos since the early 2000s. Despite this significant investment, the research outcomes have not been reflected in more significant development initiatives or government programs, which is a potential wasted opportunity for research impact. Furthermore, in the case of Laos, the Mekong beef sector has changed dramatically in the last 5 years, requiring an assessment of where existing research is relevant and what new research is needed. A new project led by Dr Rodd Dyer of FocusGroupGo Asia Pacific aims to assist in understanding the rapidly evolving situation in northern Laos beef markets. Researchers will identify areas where previous ACIAR-supported research could be valuable and future research areas in broader livestock investments.[9]

Poultry enterprises offer opportunities to improve the nutrition of households and economically empower women, who are the key custodians of smallholder poultry in South-East Asia. However, low-producing chicken genotypes typically dominate smallholder or family production systems. Dr Tadelle Dessie of the International Livestock Research Institute leads a project to test and make available high-producing, farmer-preferred genotypes of chickens to increase smallholder productivity as a pathway out of poverty in Cambodia and Vietnam. During 2022–23, the project continues activities to quantify smallholder chicken production systems and investigate promising breeds for the region. The project is also designing a breed improvement program in Cambodia.[10]

Social Systems

A farmer's decision to adopt an agricultural technology or practice involves technical, local, financial, contextual and personal factors. Therefore, efforts to encourage adoption must prioritise farmers' perceptions of problems and solutions. A project led by Dr Brian Cook of the University of Melbourne has investigated the adoption of technologies and best practice for sustainable cassava production in north-western Cambodia, where the crop area is expanding rapidly and market returns are high. The final stage of the project will be completed in 2022 with the analysis of household interviews and village engagement activities. This will inform understanding of why some groups adopt new technologies, and identify barriers specific to poor, marginalised and female-headed households.[11]

The previous project found that extension does not overcome powerful social relations, especially credit and debit. Dr Brian Cook of the University of Melbourne leads a new project to analyse the social relations that farmers actively avoid, wish to avoid, or prefer and wish to strengthen as part of self-determined efforts to improve their livelihoods. Ultimately, the project seeks to define pathways that support farmers to benefit from agricultural development. In 2022–23, the project team will collect qualitative data by engaging with 2,100 households across 30 villages.[12]

In Laos and Cambodia, access to formal financial services is low. It is substantially lower among rural and remote communities, and lower again for women. Dr Erin Taylor of Western Sydney University leads a project that will review theoretical frameworks to understand how the approach to digital financial services in Laos and Cambodia compares with global trends, and what global lessons can be applied. The project will assess theories of change and impact methodologies that have been used around the world to introduce digital financial services to reduce poverty in rural areas and improve gender equality. In 2022–23 the project team will begin gathering qualitative data through focus groups and in-depth interviews with key informants.[13]

A new project will be established in Cambodia during 2022–23, as part of the ACIAR–IDRC Research Program on One Health. Led by the Royal University of Agriculture (Cambodia), the project will investigate the role of agricultural and forest landscapes on human and environmental health in Cambodia (page 24).[14]

Soil and Land Management

Continued expansion of cultivation into unused or degraded land has been recognised as environmentally unsustainable by the Royal Government of Cambodia. Sustainable intensification, improved yields and diversification of cropping are priorities in areas where upland farming is being developed. A project led by Dr Wendy Vance of Murdoch University focuses on understanding Indigenous soil knowledge and suitable land use to develop site-specific soil management practices. The project concludes in 2022 with the delivery of simple tools to help farmers identify soil types and constraints, and soil data will be added to the Cambodian Agronomic Soils Classification system and the FAO World Reference Base for Soil Resources.[15]

The Cambodian upland landscape suffers from periods of drought, making rice farming difficult. ACIAR-supported research is enabling farmers to grow profitable crops with less water, such as rice farmer Phoun Phall, who is experimenting with growing forages instead of rice on his land. Photo: Majken Soegaard

Agricultural production in the lowlands of Cambodia and Laos is characterised by a high proportion of each nation's poorest and most food-insecure people. Their livelihoods generally rely on rainfed, low-input rice production and limited livestock keeping. A project led by Dr Matthew Denton of the University of Adelaide aims to strengthen and scale out knowledge that supports smallholder farmers in lowland areas to develop integrated forage systems on sandy soils. In 2022–23, the project team will translate their research results and information on best management practices for forages into easily understood and adoptable guidelines. They will seek to extend the knowledge gained through this project to farmers, extension agents and other stakeholders in livestock production value chains in Laos and Cambodia.[16]

Water

Inland fisheries in South-East Asia have declined significantly in recent years due to the cumulative impacts of development on freshwater ecosystems. Solutions to integrate fisheries and irrigation need to consider engineering, agronomic, environmental and social interventions, and operate across scales from field to river basin. A scoping study, led by Mr Tarek Ketelsen of the Australia Mekong Partnership for Environmental Resources and Energy Systems, aims to establish an approach for communities in the Mekong region of Cambodia and Laos to co-design interventions and systems to integrate fisheries and irrigation for more sustainable and equitable outcomes. The study forms the basis for a major project to examine integration of fisheries and irrigation in a wide range of farming systems and social contexts across South-East Asia (Cambodia, Laos, Myanmar); linking with current work on fishways and broadening the focus to include threats beyond water control infrastructure.[17]

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See page 186 for contact details.

Current and proposed projects

1. Establishing sustainable solutions to cassava diseases in mainland South-East Asia [Cambodia, Laos, Myanmar, Vietnam] (AGB/2018/172)
2. Food loss in the *Pangasius* catfish value chain of the Mekong River Basin (Food Loss Program) [Cambodia, Laos, Vietnam] (CS/2020/209)
3. Weed management techniques for mechanised and broadcast lowland crop production systems in Cambodia and Laos (CROP/2019/145)
4. FishTech: Integrating technical fisheries solutions into river development programs across South-East Asia [Cambodia, Indonesia, Laos, Vietnam, Thailand] (FIS/2018/153)
5. Building an effective forest health and biosecurity network in South-East Asia [Cambodia, Indonesia, Laos, Vietnam] (FST/2020/123)
6. Safe, fresh, year-round vegetables in Cambodia and Laos through research and development support of whole supply chain agribusiness networks (HORT/2021/143)
7. Improving mango crop management in Cambodia, the Philippines and Australia to meet market expectations (HORT/2016/190)
8. Biosecurity planning [Cambodia, Papua New Guinea] (HORT/2021/151)
9. Rapid transformation of Lao beef sector - biosecurity, trade and smallholders [Cambodia, Laos] (LS/2021/128)
10. Asian chicken genetic gains: A platform for exploring, testing, delivering, and improving chickens for enhanced livelihood outcomes in South East Asia [Cambodia, Vietnam] (LS/2019/142)
11. Uptake of agricultural technologies amongst farmers in Battambang and Pailin provinces, Cambodia (ASEM/2013/003)
12. Next generation agricultural extension: social relations for practice change [Cambodia] (SSS/2019/138)
13. Building the evidence base on the impacts of mobile financial services for women and men in farming households in Laos and Cambodia (SSS/2020/160)
14. The role of agricultural and forest landscapes on human and environmental health in Cambodia (ACIAR–IRDC One Health Research Program) (SSS/2022/164)
15. Land suitability assessment and site-specific soil management for Cambodian uplands (SMCN/2016/237)
16. Management practices for profitable crop livestock systems for Cambodia and Laos (SMCN/2012/075)
17. Water for fish and irrigation in the Mekong [Cambodia, Laos] (WAC/2021/135)

Indonesia

A$5.05 million
Budgeted funding

19
Bilateral and regional research projects

3
Small projects and activities

Indonesia's economy demonstrates impressive growth throughout 2022, recording of 5.44% (year on year) in the second quarter of 2022. This result aligns well with trends in economic recovery trends and is expected to continue in the years to come. The main strategy and relevant policies applied by the Government of Indonesia include reducing restrictions on movement of people, preparing the economy to move to a 'new normal' era, and driving affordability by providing better-targeted subsidies and social welfare supports.

Indonesia's agriculture, fisheries and forestry sectors have long been an integral part of the economy, with millions of hectares of arable land and extensive marine resources across the diverse archipelago. Although their contribution to Indonesia's GDP has declined in the past years, these sectors remain critical as they employ about one-third of the workforce. Smallholder farmers throughout rural Indonesia have proven to be the backbone of the sector, particularly during the prolonged COVID-19 crisis.

Agriculture has been one of Indonesia's most resilient sectors amidst the COVID-19 pandemic. During the COVID-19 recovery period in 2021, Indonesia's economy has started to recover gradually but unevenly across sectors. The positive performance of plantation commodities has supported the growth of the processing industry, especially the food and beverage industry. The global economic recovery is expected to boost Indonesia's agricultural exports.

Digital transformation and infrastructure development are a focus for future economic growth, driven by the increasing middle-class population, the agenda for human capital development, geographic position and positive progress in free trade agreements.

Indonesia has implemented strategies to achieve the goals of the UN 2030 Agenda for Sustainable Development, especially Sustainable Development Goal 2: Zero Hunger. The 2020–2024 National Medium-Term Development Plan includes a renewed focus on enhancement of small and medium-size enterprises and improving economic investment climate, agricultural digital transformation, land and irrigated water management and improving the governance of the national food system.

Under its nationally determined contributions submitted to the Paris Agreement, Indonesia committed to reducing greenhouse gas emissions by up to 29% with national efforts, and up to 41% with international support. A significant amount of the reductions is to come from land-based systems. To meet these commitments, Indonesia is working to enhance the use of new technologies in land management, increasing renewable technologies for energy generation, and restoring degraded peatlands. All of these initiatives have been raised with ACIAR as areas of potential collaboration.

The Indonesian Government recently established a super agency, the National Institute for Research and Innovation, which is an autonomous entity that will be responsible for R&D in all sectors. This massive reorganisation will transform the way we collaborate with Indonesia well into the future.

Country priorities

Feeding a nation of around 270 million people, especially in the context of the COVID-19 pandemic, has been reasserted as a critical priority by the Indonesian Government. The prolonged pandemic has had severe economic and non-economic impacts on the population and economy, including the agriculture, fisheries and forestry sectors. As most communities still rely on these sectors, Indonesia faces a complicated situation as the pandemic continues, with impacts on both food production and livelihoods. This is also a high-risk situation for food security due to the decrease in purchasing power and food supply chains.

In the second term of President Widodo's administration (2019–24), agriculture has attained a higher strategic position, with line agencies tasked to achieve an advanced, modern and independent agricultural system. This has strong implications for ACIAR, as it is the first major reorientation of agricultural research priorities in Indonesia for a decade, and it is focused on both market linkages and alleviating poverty through improved family farming. While Indonesia retains a strong desire to sustain current research collaboration with us in the forestry, agriculture and fisheries sectors, our new short-term and medium-term priorities of significance include:

- creating a single integrated data system to district level
- strengthening agricultural financing facilities
- improving corporate-based food crop production
- strengthening the competitiveness of dedicated horticultural zones
- improving the production, value-add and competitiveness of export crops (especially cocoa, coffee, rubber, palm oil and tea)
- strengthening biosecurity
- driving the productivity and genetic quality of livestock
- the conservation and management of forestry agroecosystems (including peatland restoration and waste management)
- improving seed systems.

Indonesia is working towards an advanced, modern and independent agricultural system, with a focus on both market linkages and alleviating poverty through improved family farming. Research priorities for collaboration with ACIAR will include driving the productivity and genetic quality of livestock in the beef and dairy sectors. Photo: Fitri Apriliyani

In 2021, a rapid assessment framework of Indonesia's Agricultural Innovation System was undertaken. The study was designed to support the Indonesian National Development Planning Ministry (BAPPENAS) in identifying policy options whereby the efficiency, effectiveness and impact of Indonesia's agricultural innovation system could be improved.

Another study is underway in 2022, which will provide key Indonesian Government agencies with a high-level 'roadmap' of high-impact initiatives and policies that could maximise the impact of digital technologies in agricultural value chains in Indonesia.

The priorities of the Ministry of Marine Affairs and Fisheries for 2021–24 are to maximise the revenue from the capture fisheries for small fishers' welfare; improve the productivity of some export-oriented commodities, especially shrimp, lobster and seaweed, supported by appropriate R&D programs; and develop aquaculture villages across Indonesia.

The integration process of R&D Agencies into the National Research and Innovation Agency (BRIN) is progressing. It provides the opportunity for ACIAR to re-calibrate its existing collaboration and explore potential areas for future partnership with technical ministries, universities, NGOs and BRIN. ACIAR will explore a new partnership model in line with Indonesia's improved economy and identify how Australia can contribute to improving Indonesia's agricultural sector.

The collaboration is identifying policy opportunities to support a major transformation of Indonesia's research, innovation and delivery systems to better support the transition of some sections of smallholder agriculture to more profitable small business enterprises, while sustaining food security for Indonesia's growing population. This collaboration is the first step towards setting new priorities and finding different ways of working together, once the constraints of the COVID-19 pandemic ease.

2022–23 research program

- **22 ACIAR-supported projects in Indonesia**
- **11 projects are specific to this country**
- **11 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Indonesia. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Research agencies in Indonesia and the international development community have focused on promoting innovative farm technologies to sustain and improve agricultural productivity in upland catchments. However, literature reviews and evaluations suggest that adoption rates of these conservation-oriented land use practices are low. Professor Randy Stringer of the University of Adelaide leads a project that aims that aims to advise the Indonesian Government on policy interventions that would enhance long-term agricultural productivity, reduce negative environmental externalities and improve household welfare in Indonesia's upland catchments. The project concludes in 2022 with an evaluation of the results of niche market interventions by sampling participating households and delivering final policy dialogue workshops with national-level stakeholders.[1]

Agriculture and tourism are interdependent sectors in Indonesia, yet there is a general absence of collaboration as they compete for local resources, including labour, land and water. Weak value chain integration limits the ability of agriculture, tourism, policy and planning entities to plan and respond to changing conditions and opportunities. A new project led by Mr Jeremy Badgery-Parker of Primary Principles Pty Ltd aims to improve the value creation of smallholders by using a network approach to understand the local agribusiness-tourism ecosystems, test consumer-based mechanisms as drivers of change and distil learnings into a transferable model. The project will lead to more resilient and economically stable communities.[2]

Smallholder farmers in South-East Asia often cannot access credit to invest in new crops or technologies, deal with risks and shocks, and safely carry wealth from harvest to planting. To help smallholders reach their production potential, a project led by Dr Alan de Brauw of the International Food Policy Research Institute aims to increase knowledge about how to design and implement innovative and inclusive agricultural value chain financing models in South-East Asia. During 2022–23, the project will analyse data to determine the impact of the project in each country and produce initial scientific reports and policy papers.[3]

Success in rural transformation is measured not only by income growth in the rural population, but also by the degree of inclusiveness in the society. A project in China, Bangladesh, Indonesia and Pakistan, led by Dr Chunlai Chen of the Australian National University, endeavours to understand the nature and drivers of rural transformation in order to provide better policy advice to underpin the success of transformation. During 2022–23, researchers will analyse and report on the results of their study into the components of success and the different impacts of rural transformation on women and men.[4]

Economic growth across South-East Asia has resulted in a growing urban middle class. This growth in affluence is driving demand for dairy-based products, and national dairy markets are growing rapidly. The increase in domestic dairy consumption in Indonesia and the Philippines presents an opportunity for significant growth in domestic dairy farming sectors, particularly for smallholder dairy farmers. A new project led by Dr Brad Granzin of Australasian Dairy Consultants aims to develop and pilot commercially viable, sustainable smallholder-inclusive dairy value chains. The project will capitalise on the growing domestic demand for short shelf-life dairy products and collaborate with partners to develop interventions to improve farm productivity, product quality and availability, and supply chain efficiencies.[5]

Crops

Mungbean is an ideal rotation crop for smallholder farmers throughout the Indian Ocean Rim region. The International Mungbean Improvement Network, established through a project led by Dr Ramakrishnan Nair of the World Vegetable Center, helped realise the potential of mungbean to improve cropping system productivity and livelihoods by improving researchers' access to genetic material, and coordinating and providing technical support to variety development in Bangladesh, India, Myanmar and Australia. Phase 2 of the project extends the network to Kenya and Indonesia, expanding the source of germplasm to develop new mungbean varieties, as well as strengthening the capacity of more national mungbean breeding programs.[6]

Fisheries

Floodplain development and the regulation of river flows for rice production across South-East Asia are affecting fisheries and fish migration, and the livelihoods of communities that depend on fish for protein and trade. Previous ACIAR-supported research showed that integrating fishways into water regulator designs, allowing passage of migratory fish up and down regulated rivers, can have lasting economic and social benefits for river communities. Professor Lee Baumgartner of Charles Sturt University leads a project to establish a stakeholder network to facilitate sound, cross-sector decision-making on fish passage construction programs across South-East Asia. During 2022–23, researchers will continue gathering data on fish migration and undertake an international review of draft guidelines and curriculum for a specially designed Graduate Certificate in Fisheries. An additional DFAT investment aims to broaden the projects outcomes to include scaling of fish passage technologies across Mekong countries.[7]

Indonesia is the world's largest producer of tuna, accounting for approximately 20% of global production. Its fishing fleet spans the eastern Indian Ocean and the western and central Pacific Ocean, and ranges from small-scale to industrial vessels. A project led by Dr Campbell Davies of CSIRO contributes to Indonesia's longer-term goal of improving the economic and social benefits of tuna fisheries, while reducing the conservation risks to regionally important fish stock. During the final year of the project, researchers will complete work with Indonesian fisheries scientists, industry and managers to evaluate harvest strategies and develop management capability for Indonesian tuna fisheries.[8]

Dependency on the tuna fishing industry is high in eastern Indonesia. Jobs in the tuna industry provide substantial sources of income and food, but many also carry significant safety risks and income insecurity. Conventional methods are typically not suitable for assessing how fisheries perform in terms of social welfare. A small research activity led by Dr Nick McClean of the University of Technology Sydney will develop and test methods for assessing harvest strategies for sustainable tuna fisheries in Indonesia, focusing on their impacts on the welfare of dependent communities. Findings will be integrated into the tuna harvest strategy being developed by the Government of Indonesia.[9]

Globally, growing momentum for nutrition-sensitive agricultural policy and development assistance is yet to have any impact on the small-scale artisanal fishery sector. To address this, the role and contribution of fish to livelihoods and nutrition security must be supported by rigorous data and communicated at global, national and local scales. A project in Timor-Leste and the East Nusa Tenggara province of Indonesia aims to identify the livelihood and nutrition benefits of fisheries and test nutrition-sensitive co-management systems for inshore fisheries. Led by Dr David Mills of the WorldFish Center, the project will evaluate the nutritional value of fisheries to households, identify the factors enabling or limiting fish consumption, and highlight the potential of fish to reduce malnutrition, particularly during early childhood. In 2022–23 activities will include data collection to understand household livelihood structures and decision-making and community training in healthy diets and child nutrition.[10]

Forestry

Tropical peatlands are a critical global ecosystem; their environmental services provide important carbon storage. Indonesia hosts the greatest global extent of tropical peatlands, yet less than 7% of its natural-state peat swamp forest is classified as intact. Without focused management, these remnants will be lost. A new project led by Dr Laura Linda Bozena Graham of The Borneo Orangutan Survival Foundation will assess the internal, edge and external threats facing a large, intact peat swamp forest area in Central Kalimantan. Researchers will develop a quantitative and qualitative threat analysis, facilitating the development of a targeted conservation strategy for the area, and a methodological report to facilitate transfer to other sites.[11]

A project with activities in Indonesia and Vietnam will underpin good plant biosecurity practices in forestry. Led by Dr Caroline Mohammed of the University of Tasmania, researchers will work with government and industry partners to extend screening approaches developed for the fungus *Ceratocystis* in acacia to eucalypts, which have replaced acacias in plantations in areas of the wet tropics. Researchers will develop remote-sensing software applications for cheap and rapid forest health surveillance and, through geospatial modelling, deliver risk maps under current and future climates at a regional level for the highest-priority pests and pathogens. In 2022–23 activities will include building the capacity of local partners to access climate data and run distribution models, and identifying eucalypt parents for hybridisation.[12]

Increased trade, global movement and a changing climate increase the threat of emerging pests and diseases. The capability to detect and respond to forest pest and disease incursions is crucial to minimising their impacts. In South-East Asia, this capacity varies widely, but there is a general lack of preparedness. A project co-led by Dr Madaline Healey and Associate Professor Simon Lawson of the University of the Sunshine Coast will establish an effective and sustainable forest biosecurity network to improve risk management for invasive forest pests and diseases. The project will use shared field protocols and data as an entry point and foundation for coordinated biosecurity response. In 2022–23 activities will include launching resources to assist with in-country identification of pests and pathogens and delivering biosecurity awareness training.[13]

Horticulture

Huánglóngbìng, or citrus greening disease, is a destructive bacterial disease of citrus. It is spread mainly by the Asian citrus psyllid and infected propagation material. All commercially cultivated citrus varieties are susceptible to the disease and, currently, there is no cure. Effective management of the disease is the largest challenge ever faced by citrus industries worldwide. A project led by Dr Jianhua Mo of the NSW Department of Primary Industries will leverage international expertise to tackle the deficiencies in current huánglóngbìng management practices. The trilateral project will enhance the sustainable management of huánglóngbìng and the Asian citrus psyllid in Indonesia and China, and increase the preparedness of the Australian citrus industry for an incursion of both the disease and the vector. In 2022–23 activities will include the evaluation of huánglóngbìng-tolerant rootstocks and transplanting of grafted seedlings to trial sites for evaluation.[14]

Fusarium wilt tropical race 4 (TR4), or Panama disease, has become widespread throughout South-East Asia. The disease is threatening smallholder banana production in Indonesia, the Philippines and, more recently, Laos. A project led by Dr Anthony Pattison of the Queensland Department of Agriculture and Fisheries aims to develop an integrated management response to the spread of the disease. The research will investigate the effects on banana production of altering the banana microbiome to suppress disease and increase plant resistance. During 2022–23, the project team will analyse completed field surveys of production systems and natural environments, and there will be ongoing development and training in statistics and experimental procedures for glasshouse and field experiments.[15]

The NSW Department of Primary Industries leads a trilateral project to enhance the sustainable management of huánglóngbìng and the Asian citrus psyllid in Indonesia and China, as well as increasing the preparedness of the Australian citrus industry for an incursion of both the disease and the vector. Photo: Fitri Apriliyani

About 40 tropical fruit fly species damage horticultural crops and impede trade throughout South-East Asia. A project in Indonesia and the Philippines builds on the success of previous ACIAR projects, and links to fruit-fly work in other ACIAR partner countries and Australia. The project, led by Mr Stefano De Faveri of the Queensland Department of Agriculture and Fisheries, aims to reduce fruit-fly infestation of mango crops through area-wide management of the pest, and improve pre-harvest and post-harvest practices. The ultimate aim is to improve the yield and quality of crops in order to improve livelihoods and trade opportunities. During 2022–23, focus areas for the project include training farmers and other stakeholders in area-wide management techniques, evaluation of techniques implemented in the field, and integration of techniques into best management practice.[16]

Livestock Systems

The Global Burden of Animal Diseases program is an ambitious 10-year initiative funded by the Bill & Melinda Gates Foundation to develop a global metrics system for animal disease burden. The program will guide public and private investments in animal health and welfare to improve our understanding of the broader societal contributions of animals at global, national, sector and farm levels. Providing improved equability for livestock and aquatic producers on the margins, particularly women, is a key driving principle. Using the conceptual framework of the program, Dr Dianne Mayberry of CSIRO will lead an ACIAR-supported project team to conduct a Global Burden of Animal Diseases case study in Indonesia to prepare a resource for prioritisation and evaluation of investments related to animal health in Indonesia.[17]

A new project will be established in Indonesia, Laos and the Philippines during 2022–23, as part of the ACIAR–IDRC Research Program on One Health. Led by the University of the Philippines (Los Banos), the project will investigate the potential to enhance livestock production systems in South-East Asia using an EcoHealth/One Health approach (page 24).[18]

Soil and Land Management

The smoke haze from indiscriminate burning of peatlands has become a major issue in South-East Asia in recent decades. Smoke haze negatively affects public health and the economy within Indonesia and other countries in the region. A multidisciplinary research program led by Dr Daniel Mendham of CSIRO supports Indonesia's commitment to restoring large areas of degraded peat and achieving sustainable livelihoods for communities living on peatland. The project concludes in 2023 with analysis, evaluation and dissemination of new knowledge to prevent fires in peatlands and improve peatland restoration practices, while enabling meaningful, profitable and sustainable alternative livelihoods.[19]

Peatland restoration efforts in Indonesia are progressing rapidly, but the success of these efforts is often low or undocumented. Two techniques trialled in previous ACIAR projects – eddy covariance flux towers and chameleon sensors – demonstrated their strong potential as tools to empower government and communities to monitor and help manage peatland restoration. These techniques monitor changes in the ecosystem's peat moisture levels and carbon and methane flux. A small research activity led by Dr Samantha Grover of RMIT University is using this data to work with communities, government agencies and other stakeholders to provide valuable information that supports decision-making in peatland restoration and fire management. Stakeholder engagement, which has commenced, is a major focus of this project.[20]

Coastal agricultural systems support the livelihoods of many people in Indonesia. These systems vary in intensity, from predominantly low-value rice production to highly intensive mixed rotations that include rice, shallot and chilli. Shallot and chilli are Indonesia's most significant vegetable commodities and are integral components of Indonesia's unique cuisine. A project led by Dr Stephen Harper of the University of Queensland addresses key soil and human health issues and challenges associated with the safe and sustainable production of high-value shallot and chilli cropping systems in coastal agroecosystems. In 2022–23 researchers will conduct experiments to compare crop productivity under different agronomic conditions and develop focused surveys to evaluate the use of pesticides in these systems and the impacts of salinity on vegetable production.[21]

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Livestock Systems: Dr Anna Okello
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See page 186 for contact details.

Current and proposed projects

1. Agricultural policy research to support natural resource management in Indonesia's upland landscapes (ADP/2015/043)
2. Creating resilient communities through smallholder-inclusive tourism markets in Indonesia (AGB/2021/125)
3. Inclusive agriculture value chain financing [Indonesia, Myanmar, Vietnam] (AGB/2016/163)
4. Understanding the drivers of successful and inclusive rural regional transformation: Sharing experiences and policy advice in Bangladesh, China, Indonesia and Pakistan (ADP/2017/024)
5. Evaluating supply chain interventions and partnerships to sustainably grow the smallholder dairy sectors of Indonesia and the Philippines (AGB/2021/124)
6. International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)
7. FishTech: Integrating technical fisheries solutions into river development programs across South-East Asia [Cambodia, Indonesia, Laos, Vietnam, Thailand] (FIS/2018/153)
8. Harvest strategies for Indonesian tropical tuna fisheries to increase sustainable benefits (FIS/2016/116)
9. Developing social and economic monitoring and evaluation systems in Indonesian tuna fisheries to assess potential impacts of alternative management measures on vulnerable communities (FIS/2020/109)
10. A nutrition-sensitive approach to fisheries management and development in Timor-Leste and Nusa Tenggara Timur Province, Indonesia (FIS/2017/032)
11. Retaining the jewels in the crown: Kalimantan peat forest remnants [Indonesia] (FST/2021/145)
12. Managing risk in South-East Asian forest biosecurity [Indonesia, Vietnam] (FST/2018/179)
13. Building an effective forest health and biosecurity network in South-East Asia [Cambodia, Indonesia, Laos, Vietnam] (FST/2020/123)
14. Preparedness and management of huánglóngbìng (citrus greening disease) to safeguard the future of citrus industry in Australia, China and Indonesia (HORT/2019/164)
15. An integrated management response to the spread of *Fusarium* wilt of banana in South-East Asia [Indonesia, Laos, Philippines] (HORT/2018/192)
16. Development of area-wide management approaches for fruit flies in mango for Indonesia, Philippines, Australia and the Asia-Pacific region (HORT/2015/042)
17. Global burden of animal disease initiative: Indonesia case study (LS/2020/156)
18. Livestock enhancement through EcoHealth/One Health assessment in South-East Asia (ACIAR–IRDC One Health Research Program) [Indonesia, Laos, Philippines] (LS/2022/163)
19. Improving community fire management and peatland restoration in Indonesia (FST/2016/144)
20. Crop health and nutrient management of shallot-chilli-rice cropping systems in coastal Indonesia (SLAM/2018/145)
21. Validating technologies for assessing and monitoring the impacts of re-wetting of peatland Indonesia using eddy flux towers coupled with the Chameleon sensors (SLAM/2020/118)

A project led by the University of Queensland addresses the key soil and human health issues and challenges of shallot and chilli cropping systems.
Photo: Adi Rahmatullah

Laos

A$4.2 million
Budgeted funding

16
Bilateral and regional research projects

4
Small projects and activities

The Lao economy has been slowed by containment measures introduced to address a second wave of COVID-19. The economic consequences of the pandemic exposed existing vulnerabilities and the country slumped into recession for the first time in more than 20 years.

Up until mid-April 2021, Laos had one of the region's lowest rates of COVID-19 cases. However, the second outbreak led to the re-introduction of containment measures that have lasted longer than those introduced in 2020. These measures restrained mobility and affected economic activities. According to the World Bank, livelihood recovery in Laos had been robust, but largely imbalanced, before the second wave of COVID-19 hit.

In its August 2021 Economic Monitor, the World Bank cited that the Lao labour market had recovered from the first wave of COVID-19, primarily driven by the ability of the agriculture sector to absorb the surplus workforce affected by pandemic shocks. Agriculture proved more resilient to pandemic shocks compared to other sectors. However, the restrictions on mobility disrupted farming activities among 14% of farming households. Because of this, more than 25% of households were very concerned about food insecurity for people in their community, an increase from 16% before the second wave began.

The World Bank expects growth in agriculture to be strong due to external demands from neighbouring countries, including China. Agricultural output was projected to grow by 3.9% in 2021, relatively higher than the 3.2% in 2020. Expanded production and export of primary agricultural products such as banana, cassava, coffee beans, live animals and rubber will drive growth. These products accounted for nearly 90% of agricultural exports in January–May 2021.

Crops and livestock farming are key drivers for future agricultural growth. In addition, the agriculture sector will continue to absorb labour that left other sectors due to the pandemic. In late 2021, the Lao–China Railway started operating. The 414 km railway is part of the Belt and Road Initiative and is expected to increase trade flows (with estimates of almost 4 million tonnes of transit trade per year by 2030), attract more foreign investors, create new jobs, and accelerate economic growth in Laos. There are high expectations that the railway will contribute to improved transportation of farm products from Laos to China.

After the 2021 UN Food Systems Summit, the Ministry of Agriculture and Forestry launched a report, Pathways to Sustainable Food Systems, which identifies 4 critical thematic areas on which the Ministry will focus. One of these is related to boosting nature-positive production, which revolves around balancing sustainable agricultural practices, people's livelihoods, and economic competitiveness with neighbouring countries. This is consistent with earlier statements of the Ministry on building its reputation for having relatively green and clean agriculture products free from the chemicals used to produce many farm products in the region.

Country priorities

In 2022–23, ACIAR will recalibrate its long-term strategic program priorities based on consultation with Lao stakeholders. The strategic priority outcomes that currently guide our investments in Laos are:

- efficient and sustainable forestry industries, including non-timber products, with suitable climate-change resilience
- innovative livestock systems that allow for intensification and land-use requirements, while raising animal health and biosecurity levels
- increased fish habitat restoration and protection of fish migration routes
- cost-effective and sustainable rice-based farming systems, through mechanisation, diversification and intensification, along with better crop quality, quarantine standards and value-adding for domestic and export markets
- improved natural resource management that benefits livelihoods and food security by delivering land-use options to smallholders, with attention to both water and nutrient management within climate-change adaptation
- improved institutional training and communication frameworks that enable smallholders to adopt and adapt new technologies, and increase the capacity development of researchers and educators.

ACIAR funds several projects to improve the productivity and resilience of cassava production systems and value chains, as cassava mosaic virus continues to affect crops across South-East Asia.

2022–23 research program

- **20 ACIAR-supported projects in Laos**
- **5 projects are specific to this country**
- **15 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Laos. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Cassava witches' broom disease and Sri Lanka cassava mosaic virus are spreading rapidly in South-East Asia. A project led by Dr Jonathan Newby of the International Center for Tropical Agriculture is developing technically viable and economically and socially sustainable ways to improve the resilience of cassava production systems and value chains in Cambodia, Laos, Myanmar and Vietnam. The project will conclude in 2023 with researchers continuing on-farm testing of new agronomic practices and training of farmers and extension officers. The project team will also finalise their investigation of alternative models for public-private funding for core activities.[1]

Catfish (*Pangasius* sp) farming and wild-caught catfish are important income generating activities for smallholder farmers in the Mekong River Basin and are a vital source of dietary protein for those countries' populations. The continued availability of catfish for human consumption is influenced by many factors including climate change, the COVID-19 pandemic, consumer perceptions on food and health safety provenance, and environmental and political changes. Dr Van Kien Nguyen of the Health and Agricultural Policy Research Institute leads a new project in Cambodia, Laos and Vietnam to identify food loss and waste along the catfish value chain; conduct foresight exercises to determine the uncertainties of catfish production for food systems; and develop solutions to reduce food loss in catfish production. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).[2]

Crops

New crop establishment practices for rice, such as broadcasting and direct seeding (manually or mechanically), offer significant labour savings for growers. However, changed field conditions compared with traditional crop establishment methods, such as transplanting, increase the risk of weed infestations. A project in Cambodia and Laos, led by Dr Jaquie Mitchell of the University of Queensland, is developing weed management packages to address labour constraints and reduce the reliance on chemical control. The project is engaging with farmer groups and their advisers to determine knowledge gaps in weed management, and identify practical solutions to develop integrated weed management packages suitable for rainfed lowland rice production systems, specific to locations.[3]

ACIAR-supported research has showed that integrating fishways into water regulator designs, allowing passage of migratory fish up and down regulated rivers, can have lasting economic and social benefits for river communities.

Fisheries

Floodplain development and the regulation of river flows for rice production across South-East Asia are affecting fisheries and fish migration, and the livelihoods of communities that depend on fish for protein and trade. Previous ACIAR-supported research showed that integrating fishways into water regulator designs, allowing passage of migratory fish up and down regulated rivers, can have lasting economic and social benefits for river communities. Professor Lee Baumgartner of Charles Sturt University leads a project to establish a stakeholder network to facilitate sound, cross-sector decision-making on fish passage construction programs across South-East Asia. During 2022–23, researchers will continue gathering data on fish migration and undertake an international review of draft guidelines and curriculum for a specially designed Graduate Certificate in Fisheries. An additional DFAT investment aims to broaden the projects outcomes to include scaling of fish passage technologies across Mekong countries.[4]

The Xayaburi Power Company, responsible for designing and constructing the Xayaburi hydro-electric dam across the Mekong River in Laos, built a complex fishway system designed to enable the upstream and downstream passage of migratory fish. There are hundreds of species of fish in the Mekong River, varying in size from a few centimetres to more than one metre. A project team led by Professor Lee Baumgartner of Charles Sturt University is working with the Xayaburi Power Company to develop robust tools and techniques to assess the effectiveness of the Xayaburi Dam fish passage facilities and provide a standard for other hydro-electric dams planned for the mainstem Mekong River.[5]

Forestry

Increased trade, global movement and a changing climate increase the threat of emerging pests and diseases. The capability to detect and respond to forest pest and disease incursions is crucial to minimising their impacts. In South-East Asia, this capacity varies widely, but there is a general lack of preparedness. A project co-led by Dr Madaline Healey and Associate Professor Simon Lawson of the University of the Sunshine Coast will establish an effective and sustainable forest biosecurity network to improve risk management for invasive forest pests and diseases. The project will use shared field protocols and data as an entry point and foundation for coordinated biosecurity response. In 2022–23 activities will include launching resources to assist with in-country identification of pests and pathogens and delivering biosecurity awareness training.[6]

Lao wood manufacturing industries are yet to adopt contemporary processing technologies used in neighbouring countries. Research led by Dr Hilary Smith of the University of Melbourne will complete the development of new processing capability and engineered wood products from small-diameter timbers. This research benefits wood manufacturing industries in Laos by increasing capacity and growing markets for timber from new plantations, and in Australia by increasing the use of underused plantation resources. During 2022–23, reports will be completed on the characterisation of the current plantation resource and options for modelling future wood supply, as well as prospective pathways for influence and change in relevant policy, governance and administrative environments.[7]

Laos has an ambitious target of 70% forest cover by 2030, but currently nearly half of the country is degraded or unstocked forest. The Government of Laos seeks to restore native forest while providing benefits to resident and neighbouring communities. A new project addresses the opportunity to shape reforestation policy and practice, determining how to fulfil the government requirements. Professor Patrick Baker of the University of Melbourne leads this project, which will test post-disturbance treatments to accelerate and channel forest recovery towards desired economic, social, and ecological outcomes. By testing ecosystem assembly theory, the project will advance the state of the art in forest restoration.[8]

Horticulture

Appropriate low-cost protected cropping provides an opportunity to develop inclusive economies around vegetable production using collaborative supply chains to grow and market traceable, safe, fresh vegetables. A new project led by Mr Jeremy Badgery-Parker of the University of Adelaide will address the technical and social challenges of year-round safe, reliable vegetable production through understanding the inputs and outputs of these production systems. The project will support smallholder farmers in Cambodia and Laos to be climate-resilient, sustain natural landscapes, minimise waste and emissions, and significantly increase yields leading to increased income.[9]

Fusarium wilt tropical race 4 (TR4), or Panama disease, has become widespread throughout South- East Asia. The disease is threatening smallholder banana production in Indonesia, the Philippines and, more recently, Laos. A project led by Dr Anthony Pattison of the Queensland Department of Agriculture and Fisheries aims to develop an integrated management response to the spread of the disease. The research will investigate the effects on banana production of altering the banana microbiome to suppress disease and increase plant resistance. During 2022–23, the project team will analyse completed field surveys of production systems and natural environments, and there will be ongoing development and training in statistics and experimental procedures for glasshouse and field experiments.[10]

Livestock Systems

ACIAR has funded cattle research in Cambodia and Laos since the early 2000s. Despite this significant investment, the research outcomes have not been reflected in more significant development initiatives or government programs, which is a potential wasted opportunity for research impact. Furthermore, in the case of Laos, the Mekong beef sector has changed dramatically in the last 5 years, requiring an assessment of where existing research is relevant and what new research is needed. A new project led by Dr Rodd Dyer of FocusGroupGo Asia Pacific aims to assist in understanding the rapidly evolving situation in northern Laos beef markets. Researchers will identify areas where previous ACIAR-supported research could be valuable and future research areas in broader livestock investments.[11]

Laos is a comparatively small producer of pork compared with Vietnam and China, but pork production has grown significantly in recent years. Improved safety of animal source foods that is free from zoonotic parasites such as *Taenia solium*, or pork tapeworm, is gaining greater attention in the region. Dr Amanda Ash of Murdoch University leads a project to identify and recommend interventions to mitigate the risk of disease from food-borne parasites in pigs, adding value to the growing cross-border pig trade between northern Laos and Vietnam. During 2022–23, the project will implement protocols to manage food-borne parasitic disease at the farm level, such as deworming and subsequent monitoring of livestock and human health; and determine the effectiveness of engagement and communication packages for education of people in high-risk villages.[12]

Goat production in Laos has more than doubled over the past 10 years, largely driven by high demand for goat meat from Vietnam. Traditional extensive goat-raising methods can result in overgrazing of feed resources, negative consequences for the environment and higher incidence of diseases and parasites in livestock. A project led by Professor Stephen Walkden-Brown of the University of New England is aiming to enhance income-generating opportunities for goats in Lao farming systems, while identifying sustainable production practices. Additionally, the project is seeking greater understanding of consumer preferences for goats in Vietnam to further develop market specifications, especially for premium meat. During 2022–23, the project will develop performance benchmarks and define best practice for smallholders, larger goat farmers and agroforestry systems. The project will also conduct market surveys to ascertain past, current and likely future demand for goats and goat meat, and factors affecting pricing and demand.[13]

A new project will be established in Indonesia, Laos and the Philippines during 2022–23, as part of the ACIAR–IDRC Research Program on One Health. Led by the University of the Philippines (Los Banos), the project will investigate the potential to enhance livestock production systems in South-East Asia using an EcoHealth/One Health approach (page 24).[14]

Social Systems

In Laos and Cambodia, access to formal financial services is low. It is substantially lower among rural and remote communities, and lower again for women. Dr Erin Taylor of Western Sydney University leads a project that will review theoretical frameworks to understand how the approach to digital financial services in Laos and Cambodia compares with global trends, and what global lessons can be applied. The project will assess theories of change and impact methodologies that have been used around the world to introduce digital financial services to reduce poverty in rural areas and improve gender equality. In 2022–23 the project team will begin gathering qualitative data through focus groups and in-depth interviews with key informants.[15]

The Lao Government increasingly demands evidence to support policy development. The relationship between research-for-development and policy has not been clear-cut and there is an identified need for ACIAR projects to adopt more effective research-to-policy approaches in the Lao context. Dr Hilary Smith and Professor Peter Kanowski from the Australian National University will report on their analysis case studies and in-depth interviews with key stakeholders to identify the processes, practices and circumstances that facilitate or hinder the influence and uptake of ACIAR-commissioned research within Lao policy contexts.[16]

Soil and Land Management

Agricultural production in the lowlands of Cambodia and Laos is characterised by a high proportion of each nation's poorest and most food-insecure people. Their livelihoods generally rely on rainfed, low-input rice production and limited livestock keeping. A project led by Dr Matthew Denton of the University of Adelaide aims to strengthen and scale out knowledge that supports smallholder farmers in lowland areas to develop integrated forage systems on sandy soils. In 2022–23, the project team will translate their research results and information on best management practices for forages into easily understood and adoptable guidelines. They will seek to extend the knowledge gained through this project to farmers, extension agents and other stakeholders in livestock production value chains in Laos and Cambodia.[17]

Strong market demand for concentrated livestock feeds to support livestock industries resulted in a maize boom in Vietnam and Laos and a rapid shift to annual cropping. Fluctuations in maize price, soil erosion and declining soil fertility have pressured governments and communities into looking for alternative land use options. A small research activity led by Professor Michael Bell of the University of Queensland proposes to use an established network of researchers, extension agents and traders as the basis for developing a Theory of Change focused on maize production areas in Vietnam and Laos. It will explore opportunities to link institutional research and private sector development capacity in these regions to stimulate and support the development of economically and environmentally sustainable, climate change resilient agricultural systems.[18]

Increasing numbers of smallholder farmers in Laos and northern Vietnam are growing maize on sloping land to meet demand for livestock feeds by poultry, pig and cattle industries in China and South-East Asia. A project led by Professor Michael Bell of the University of Queensland is helping farmers adopt maize-based farming systems that reduce soil degradation and improve smallholder livelihoods and economic viability. The project concludes in 2022 with the delivery of outreach models to support the adoption of more diversified maize-based farming systems and bioeconomic frameworks to structure the assessment of the sustainability and productivity of different crop and forage options.[19]

Water

Inland fisheries in South-East Asia have declined significantly in recent years due to the cumulative impacts of development on freshwater ecosystems. Solutions to integrate fisheries and irrigation need to consider engineering, agronomic, environmental and social interventions, and operate across scales from field to river basin. A scoping study, led by Mr Tarek Ketelsen of the Australia Mekong Partnership for Environmental Resources and Energy Systems, aims to establish an approach for communities in the Mekong region of Cambodia and Laos to co-design interventions and systems to integrate fisheries and irrigation for more sustainable and equitable outcomes. The study forms the basis for a major project to examine integration of fisheries and irrigation in a wide range of farming systems and social contexts across South-East Asia (Cambodia, Laos, Myanmar); linking with current work on fishways and broadening the focus to include threats beyond water control infrastructure.[20]

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See page 186 for contact details.

A project led by the University of Adelaide aims to strengthen and scale out knowledge that supports smallholder farmers in lowland areas to develop integrated forage systems on sandy soils.

Current and proposed projects

1. Establishing sustainable solutions to cassava diseases in mainland South-East Asia [Cambodia, Laos, Myanmar, Vietnam] (AGB/2018/172)
2. Food loss in the *Pangasius* catfish value chain of the Mekong River Basin (Food Loss Program) [Cambodia, Laos, Vietnam] (CS/2020/209)
3. Weed management techniques for mechanised and broadcast lowland crop production systems in Cambodia and Laos (CROP/2019/145)
4. FishTech: Integrating technical fisheries solutions into river development programs across South-East Asia [Cambodia, Indonesia, Laos, Vietnam, Thailand] (FIS/2018/153)
5. Assessing upstream fish migration measures at Xayaburi Dam in Laos (FIS/2017/017)
6. Building an effective forest health and biosecurity network in South-East Asia [Cambodia, Indonesia, Laos, Vietnam] (FST/2020/123)
7. Advancing enhanced wood manufacturing industries in Laos and Australia (FST/2016/151)
8. Forest restoration for economic outcomes (FST/2020/137)
9. Safe, fresh, year-round vegetables in Cambodia and Laos through research and development support of whole supply chain agribusiness networks (HORT/2021/143)
10. An integrated management response to the spread of *Fusarium* wilt of banana in South-East Asia [Indonesia, Laos, Philippines] (HORT/2018/192)
11. Rapid transformation of Lao beef sector - biosecurity, trade and smallholders [Cambodia, Laos] (LS/2021/128)
12. Investigating and developing interventions to mitigate food borne parasitic disease in production animals in Laos (LS/2014/055)
13. Goat production systems and marketing in Laos and Vietnam (LS/2017/034)
14. Livestock enhancement through EcoHealth/One Health assessment in South-East Asia (ACIAR–IRDC One Health Research Program) [Indonesia, Laos, Philippines] (LS/2022/163)
15. Building the evidence base on the impacts of mobile financial services for women and men in farming households in Laos and Cambodia (SSS/2020/160)
16. Policy impact in Laos: From research to practice (SSS/2020/142)
17. Management practices for profitable crop livestock systems for Cambodia and Laos (SMCN/2012/075)
18. Embedding knowledge and exploring future research opportunities in sloping land agricultural systems in northern Laos and northwest Vietnam (SLAM/2021/152)
19. Improving maize-based farming systems on sloping lands in Vietnam and Laos (SMCN/2014/049)
20. Water for fish and irrigation in the Mekong [Cambodia, Laos] (WAC/2021/135)

Myanmar

A$0.79 million
Budgeted funding

3
Bilateral and regional research projects

A year after the coup that overthrew Myanmar's elected civilian government, the World Bank estimated that Myanmar's economy shrank 18% in 2021 and forecasted that continuing political instability and the COVID-19 pandemic would slow recovery in 2022.

The Myanmar Economic Monitor reports that the share of Myanmar's population living in poverty has doubled compared to pre-COVID-19 levels. The report also states that ongoing economic pressures are substantially affecting vulnerability and food security, particularly for the poor, whose savings have been drained because of recent shocks. This is consistent with findings reported under the Myanmar Agriculture Policy Support Activity supported by the International Food Policy Research Institute (IFPRI). In September 2021, IFPRI reported 48% of their respondents cited food supply problems (compared to 32% in May 2021) and 41% cited loss of jobs or income (compared to 31% in May 2021).

Prior to the political turmoil and the COVID-19 pandemic, more than one-third of Myanmar's population was already in poverty, and 6% were in extreme poverty. Almost 70% of Myanmar's 54 million people live in rural areas and rely on crop production and fisheries or livestock for their livelihoods and incomes. The fishery and livestock sectors are considered the most important, after agriculture, to meet the protein needs of the population, enhance food security, and provide employment for rural communities. The agriculture sector used to contribute about 30% of Myanmar's GDP. The political instability and a devastating third wave of the COVID-19 pandemic caused the price of critical inputs such as fertiliser to soar while crop prices have fallen.

Poverty and food insecurity are soaring in Myanmar's Central Dry Zone and Ayeyarwady Delta regions, the country's agricultural heartland. The rising food insecurity and poverty in these regions will have far-reaching repercussions in Myanmar, which relies heavily on the agricultural sector.

Country priorities

In 2020, research priorities for the ACIAR program in Myanmar aligned with 2 of the 3 focuses of Myanmar's Agricultural Development Strategy and Investment Plan (2018–2023): productivity, and market linkages and competitiveness. Specifically, the ACIAR program in Myanmar is focused on:

- increasing net production of food and cash incomes of rural households in the Central Dry Zone and Ayeyarwady Delta, through improvements in, and adoption of, production and post-harvest technologies in agriculture, including livestock and fisheries

- building capacity in agricultural, livestock and fisheries research, development and evaluation through program activities and postgraduate and short-term training
- providing technical assistance and advice on policy strengthening to relevant Government of Myanmar departments
- linking Myanmar regionally through multi-country research collaborations.

Following the rapid global spread of the COVID-19 from early 2020, Australia's program of development cooperation pivoted quickly to respond to the challenges being faced by the Indo-Pacific region, with a focus on health security, stability and (of particular importance to ACIAR) economic recovery. Specifically, as part of Australia's Myanmar COVID-19 Response Plan, ACIAR committed to continuing to support improvements in food production and rural incomes through improvements in agriculture, livestock and fisheries.

The political instability sparked by the military coup of February 2021 has resulted in Australia's development program with Myanmar being redirected to support the immediate humanitarian needs of the most vulnerable and poor, with non-government partners coordinating implementation.

2022–23 research program

- **3 ACIAR-supported projects in Myanmar**
- **3 projects are part of regional projects**

ACIAR is not supporting any new research collaborations in 2022–23. However, ACIAR continues to work with each of the current projects, in consultation with international partners, to identify how collaboration might continue consistent with Australian government guidelines.

Agribusiness

Cassava witches' broom disease and Sri Lanka cassava mosaic virus are spreading rapidly in South-East Asia. A project led by Dr Jonathan Newby of the International Center for Tropical Agriculture is developing technically viable and economically and socially sustainable ways to improve the resilience of cassava production systems and value chains in Cambodia, Laos, Myanmar and Vietnam. The project will conclude in 2023 with researchers continuing on-farm testing of new agronomic practices and training of farmers and extension officers. The project team will also finalise their investigation of alternative models for public-private funding for core activities.[1]

Smallholder farmers in South-East Asia often cannot access credit to invest in new crops or technologies, deal with risks and shocks, and safely carry wealth from harvest to planting. To help smallholders reach their production potential, a project led by Dr Alan de Brauw of the International Food Policy Research Institute aims to increase knowledge about how to design and implement innovative and inclusive agricultural value chain financing models in South-East Asia. During 2022–23, the project will analyse data to determine the impact of the project in each country and produce initial scientific reports and policy papers.[2]

Crops

Mungbean is an ideal rotation crop for smallholder farmers throughout the Indian Ocean Rim region. The International Mungbean Improvement Network, established through a project led by Dr Ramakrishnan Nair of the World Vegetable Center, helped realise the potential of mungbean to improve cropping system productivity and livelihoods by improving researchers' access to genetic material, and coordinating and providing technical support to variety development in Bangladesh, India, Myanmar and Australia. Phase 2 of the project extends the network to Kenya and Indonesia, expanding the source of germplasm to develop new mungbean varieties, as well as strengthening the capacity of more national mungbean breeding programs.[3]

Regional Manager, East & South-East Asia
Ms Dulce Carandang Simmanivong

Research Program Managers
Agribusiness: Mr Howard Hall
Crops: Dr Eric Huttner

See page 186 for contact details.

Current and proposed projects

1. Establishing sustainable solutions to cassava diseases in mainland South-East Asia [Cambodia, Laos, Myanmar, Vietnam] (AGB/2018/172)
2. Inclusive agriculture value chain financing [Indonesia, Myanmar, Vietnam] (AGB/2016/163)
3. International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)

Philippines

A$4.47 million
Budgeted funding

14
Bilateral and regional research projects

1
Small projects and activities

The Philippine economy is steadily recovering from the 9.5% contraction in 2020 brought about by natural disasters such as volcanic eruptions and strong typhoons, and the COVID-19 pandemic. The Philippines was heavily impacted by one of the world's longest and strictest enforced periods of community quarantine, which led to many businesses shutting down, increased unemployment and loss of income among workers in the informal sector, and a reduction in domestic consumption and purchasing power.

In 2021, with the calibrated reopening of businesses and mass transportation and the relaxation of quarantine restrictions, economic activities gradually resumed, resulting in a 5.6% economic growth, moving closer to the pre-pandemic average growth rates over the last decade of about 6%. While the agriculture sector remained resilient in early 2020, the lingering African swine fever and many strong typhoons have eroded the gains and made recovery efforts challenging.

Food insecurity remains a significant issue for the poorest and most vulnerable. To address this, the Philippine government is working on increasing food sufficiency levels through various initiatives such as the Rice Competitiveness Enhancement Fund, loan programs and farm-to-market assistance and disease management.

The Department of Science and Technology – Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST–PCAARRD) is the main government partner of ACIAR in the Philippines. In support of national efforts to mitigate the impacts of the pandemic on agriculture and food systems, PCAARRD initiated a COVID-19 response program, GALING-PCAARRD, which assists communities around the country through technology information sharing, food product distribution, and provision of food production technologies and livelihood opportunities. It also focuses on enabling innovative research and development and integrating the different DOST agencies' initiatives in partnership with the State Universities and Colleges to enhance the food value chain for selected commodities in the regions towards food resilience.

Since the launch of the National Food Policy in January 2021, which directed all public-led initiatives related to hunger, food security, nutrition and sustainable agriculture, to be well coordinated and responsive across national and regional levels, there have been modest improvements in the hunger rate from 21.1% in 2020 to 11.8% by the end of 2021. The Inter-Agency Task Force for Zero Hunger created a roadmap that addresses the fragmented agriculture supply chain prone to disruptions, massive food waste, huge losses for farmers, higher costs and lower quality for consumers. However, while these efforts are laudable, there is still a lot to be done to further reduce hunger rates to pre-pandemic levels and, ultimately, end hunger.

The Philippines is one of Australia's longest-standing bilateral relationships, celebrating 76 years of diplomatic relationship in 2022. Bilateral cooperation is underpinned by the Philippines–Australia Comprehensive Partnership and the Philippines–Australia General Agreement on Development Cooperation. As one of the major bilateral partners for the Philippines, Australia remains committed to collaborate with the Philippine Government on recovery efforts and the country's development.

Country priorities

ACIAR has worked with the Philippine Government, research and academic institutions, private sector and civil society partners for 4 decades, governed by the Memorandum of Agreement for Philippine–Australian collaboration in agriculture and forestry research. Country partnerships have evolved in recent years with significant co-investment from our main bilateral partner, DOST-PCAARRD, and with a deepening of the partnership as defined in the 2018 Record of Partnering Arrangements between PCAARRD and ACIAR for Scientific and Technical Cooperation for Agriculture, Aquatic and Natural Resources.

Our program in the Philippines focuses on research to make agricultural products more marketable and internationally competitive and to build the resilience of smallholder farmers, fishers and their households from impacts of natural disasters, climate change and external shocks such as the COVID-19 pandemic. Higher-value products and market competitiveness would improve food security by enabling smallholder farmers and traders to increase their income and access to other basic services and economic opportunities.

We work with the Philippine Government to progress the Harmonised National Research and Development Agenda for Agriculture, Aquatic and Natural Resources to promote prosperity, reduce poverty, and enhance stability. We do this through research for development that aims to:

- improve agriculture and food production systems
- make agricultural products more competitive in the market
- enable competitive and sustainable fisheries and aquaculture
- improve land and water resource management for profitable and sustainable agriculture
- build resilience to climate change and other natural shocks
- increase adoption of technology through community engagement, enabling extension services and support to policy development.

These priorities remain relevant, and the underlying issues have been compounded considering the COVID-19 pandemic.

The ACIAR program in the Philippines focuses on research to make agricultural products more marketable and internationally competitive and to build the resilience of smallholder farmers, fishers and their households. Photo: Ryam Yap

During 2020, ACIAR examined food systems in the Philippines to identify vulnerabilities exposed or amplified by the COVID-19 shock. This information, published in ACIAR Technical Report 96 *COVID-19 and food systems in the Indo-Pacific: An assessment of vulnerabilities, impacts and opportunities for action*, continues to be relevant in informing research and development to support food systems resilience in the Philippines. In particular, the assessment helped identify focus areas for research collaboration in the Philippines that will contribute to increasing food systems resilience in the face of future shocks.

Capacity building is closely linked to our research initiatives. Opportunities include the John Allwright Fellowship, the John Dillon Fellowship, the Meryl William Fellowships and other initiatives under the alumni engagement plan. Each program focuses on leadership and career development through short and medium-term support for Philippine partners. In August 2022, ACIAR and the Department of Science and Technology (DOST) entered into a new partnership to pilot a joint fellowship program with co-investments from both organisations to send Filipino researchers to Australia for their PhD.

In recent years, ACIAR has introduced innovations to deliver our learning and development programs. One example is the Philippine Agribusiness Masterclass, which successfully brought together a cohort of researchers, academics, farmer leaders and representatives from the private sector to collaborate. This course has now been integrated as a regular course offering of the DOST-PCAARRD, with a second cohort starting in the program last August 2022. In 2021, the John Dillon Fellowship was redesigned and is currently being delivered in-country to a cohort of up to 20 participants with a strong focus on cross-organisational collaboration and strengthening ties with Australian collaborators. The first in-country fellowship program commenced in the Philippines in May 2021, with participants from key government and research partners. The fellows are currently focused on their research projects which are expected to be completed before the end of 2022.

Australian Alumni play an important role as partners in research for development. ACIAR supported the establishment of the first Agriculture, Aquatic and Natural Resources Community of Practice in the Philippines in 2022, with an initial membership of 27 ACIAR alumni who are committed to 'best fit' solutions and approaches to the challenges in the sector.

Outreach and communications are increasingly important as a means to strengthen understanding and awareness of the impact of our programs as part of Australia's aid program in the Philippines, to support and strengthen relationships between in-country project partners and stakeholders and to share knowledge generated from ACIAR supported research programs to the public and policymakers.

2022–23 research program

- **15 ACIAR-supported projects in the Philippines**
- **9 projects are specific to this country**
- **6 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in the Philippines. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Economic growth across South-East Asia has resulted in a growing urban middle class. This growth in affluence is driving demand for dairy-based products, and national dairy markets are growing rapidly. The increase in domestic dairy consumption in Indonesia and the Philippines presents an opportunity for significant growth in domestic dairy farming sectors, particularly for smallholder dairy farmers. A new project led by Dr Brad Granzin of Australasian Dairy Consultants aims to develop and pilot commercially viable, sustainable smallholder-inclusive dairy value chains. The project will capitalise on the growing domestic demand for short shelf-life dairy products and collaborate with partners to develop interventions to improve farm productivity, product quality and availability, and supply chain efficiencies.[1]

ACIAR-supported research in the southern Philippines showed that integrating vegetable and coffee value-chain development and community engagement leads to improved innovation, competitiveness, quality and value. However, success occurred at very local scales and, in general, most smallholder horticulture growers in the Philippines cannot compete in higher-value, more-demanding markets. A project led by Dr Lily Lim-Camacho of CSIRO will identify opportunities for inclusive agribusiness-led market development, evaluate opportunities for digital technologies to increase competitiveness and farm-to-market linkages, and evaluate models for public–private learning alliances and innovative co-investment with agribusiness firms. In 2022–23, researchers will conduct participatory community and vegetable and coffee farming systems analysis.[2]

Fisheries

In the Philippines, the successful restoration of damaged coral reefs in experimental plots has led to notable increases in reef fish abundance and fish species richness, compared with control plots where coral was not restored. A project led by Professor Peter Harrison of the Southern Cross University has established rigorous protocols and long-term monitoring and evaluation of the impacts on fish communities and other reef resources from coral restoration in the northern Luzon region. The project concludes in 2022 with training courses for local communities, reef managers and researchers to build capacity for future fish surveys, reef restoration programs and best-practice reef fisheries management.[3]

Previous ACIAR research partnerships successfully demonstrated rapid coral population recovery, re-establishment of breeding populations and increased fish abundance from larval coral restoration interventions. Professor Peter Harrison of the Southern Cross University leads a 5-year project to significantly increase the scale of restoration interventions. Techniques established in previous projects will be refined for application in large-scale restoration trials in 4 regions of the Philippines. Trials will be monitored to quantify coral reproduction success. In 2022–23 the project team will continue working with communities, researchers and local governments to establish coral restoration networks in the trial regions to support local restoration activities. Heat-stress experiments will be conducted to quantify larval production, settlement and recruitment rates to identify heat-tolerant adult coral genotypes that are resilient under future climate-change scenarios.[4]

Coral reef ecosystems provide important livelihood opportunities to coastal communities in the Philippines, but they are threatened by climate change, overfishing, destructive fishing practices and pollution. While the success of coral restoration using larval reseeding techniques has been confirmed by previous and ongoing ACIAR-supported projects, significant challenges remain regarding the integration of this technology with existing maritime policy and governance to ensure the sustainability of restored reefs. Associate Professor Michael Fabinyi of the University of Technology Sydney leads a project funded by DFAT that aims to improve the institutional effectiveness of coral reef restoration by understanding political-economic influences and drivers at multiple scales, and applying lessons learned through a marine governance network-based approach.[5]

Dried sea cucumbers are highly valued in markets across China and South-East Asia. Overfishing and poor fisheries management throughout the Asia-Pacific region have resulted in serious declines of sea cucumber stocks and even led to fishery closures, reducing income-generating opportunities for coastal communities. A project led by Professor Paul Southgate of the University of the Sunshine Coast is developing culture methods that support pond-based sea cucumber farming in Vietnam and sea-based farming in the Philippines. In 2022–23 activities will include assessing potential predator mitigation measures, continuing field experiments and developing protocols for the responsible use and transfer of sandfish.[6]

Dried sea cucumbers are highly valued in markets across China and South-East Asia. A project led by the University of the Sunshine Coast is developing culture methods that support sea cucumber farming in the Philippines and Vietnam. Photo: Mark Anthony Perandos

Horticulture

Fusarium wilt tropical race 4 (TR4), or Panama disease, has become widespread throughout South-East Asia. The disease is threatening smallholder banana production in Indonesia, the Philippines and, more recently, Laos. A project led by Dr Anthony Pattison of the Queensland Department of Agriculture and Fisheries aims to develop an integrated management response to the spread of the disease. The research will investigate the effects on banana production of altering the banana microbiome to suppress disease and increase plant resistance. During 2022–23, the project team will analyse completed field surveys of production systems and natural environments, and there will be ongoing development and training in statistics and experimental procedures for glasshouse and field experiments.[7]

About 40 tropical fruit fly species damage horticultural crops and impede trade throughout South-East Asia. A project in Indonesia and the Philippines builds on the success of previous ACIAR projects, and links to fruit-fly work in other ACIAR partner countries and Australia. The project, led by Mr Stefano De Faveri of the Queensland Department of Agriculture and Fisheries, aims to reduce fruit-fly infestation of mango crops through area-wide management of the pest, and improve pre-harvest and post-harvest practices. The ultimate aim is to improve the yield and quality of crops in order to improve livelihoods and trade opportunities. During 2022–23, focus areas for the project include training farmers and other stakeholders in area-wide management techniques, evaluation of techniques implemented in the field, and integration of techniques into best management practice.[8]

Vegetable consumption is low in the Philippines for several reasons, including the perception that vegetables are of poor quality and unsafe. Vegetable farmers are not well trained in the appropriate use of pesticides, resulting in pesticide residues above permissible limits in harvested crops, exposure of farm workers to pesticide poisoning and contamination of soil and water. Dr Gordon Rogers of Applied Horticultural Research leads a project to improve vegetable supply chains to meet consumer expectations in terms of quality, food safety, nutritional value and price. During 2022–23, the project will continue to measure the social and economic impact of adopting new vegetable good agricultural practice (GAP) protocol and continue training key support personnel, including leading farmers.[9]

Mango production in the Asia-Pacific region accounts for about two-thirds of global production. Much of the crop is produced by smallholders, who achieve relatively modest yields and participate in traditional value-chain arrangements that offer little incentive to innovate or pursue higher quality. Some producers seek better returns by supplying higher-value export markets (such as Korea), but struggle to deliver fruit that meets market or regulatory standards. Dr Muhammad Sohail Mahzar of the Northern Territory Department of Primary Industry and Fisheries Industry, Tourism and Trade will lead a new project in Cambodia and the Philippines that aims to improve the ability of selected mango supply chains to deliver fruit that better meets consumer expectations of quality and value, and provide smallholder growers with a better return on investment.[10]

Livestock Systems

A new project will be established in Indonesia, Laos and the Philippines during 2022–23, as part of the ACIAR–IDRC Research Program on One Health. Led by the University of the Philippines (Los Banos), the project will investigate the potential to enhance livestock production systems in South-East Asia using an EcoHealth/One Health approach (page 24).[11]

The University of the Philippines will also lead a second project in the program to develop a policy approach to support the Philippines' national surveillance and control programs for African swine fever, avian influenza and antimicrobial resistance.[12]

Social Systems

More than 24 million people in the Philippines, most of whom live below the poverty line and rely on subsistence agriculture, especially in the country's rural uplands. Deforestation and land degradation in the uplands are major national environmental and social issues. A project led by Dr Nestor Gregorio of the University of the Sunshine Coast focuses on forest landscape restoration to enhance the livelihoods of low-income residents of rural areas. During 2022–23, information from pilot testing of designs for woodlots, agroforestry systems and woodlot/crop systems suited to smallholders and communities will be used to produced manuals on smallholder-based tree-crop farming systems. Guidelines also will be published to assist the formulation of forest and landscape restoration policy within the Asia-Pacific region.[13]

Soil and Land Management

Rubber is the fourth largest crop in the poorest province of the southern Philippines, Agusan del Sur. Only 50% of the total rubber area planted is productive or tappable, and average yield in the province is much lower than the national average. By introducing improved profitable rubber-based intercropping systems and sustainable management regimes, a project led by Professor Chengrong Chen of Griffith University aims to boost household incomes for Indigenous smallholder subsistence farmers. During 2022–23, the project team will finalise intervention strategies to ensure gender equity, report on the best nutrient and fertiliser management schemes for increasing soil fertility, and continue delivering capacity building activities to promote resilient market-oriented rubber-based intercropping systems with low risk and high productivity and profitability.[14]

Vegetable production systems of upland farming areas of the Philippines are intensively managed and suffer problems including severe soil acidity, undiagnosed micronutrient deficiencies, excessive accumulation of copper and zinc, excessive application of fertilisers and manures, and erosion. Serious soil-borne pathogens also affect productivity in these intensive farming systems. Dr Stephen Harper of the University of Queensland leads a new project to develop management strategies that mitigate, remediate and reduce the risks of contaminants in soils across 3 major vegetable production regions. The project starts with research to provide a clear understanding and validation of the current soil nutrient status, including excesses and deficiencies, and potential short-term and long-term impacts of accumulation of essential heavy metals, particularly copper and zinc, on vegetable production.[15]

Country Manager, The Philippines
Ms Hazel Aniceto

Research Program Managers
Agribusiness: Mr Howard Hall
Fisheries: Prof Ann Fleming
Horticulture: Ms Irene Kernot
Livestock: Dr Anna Okello
Social Systems: Dr Clemens Grünbühel
Soil and Land Management: Dr James Quilty

See page 186 for contact details.

Current and proposed projects

1. Evaluating supply chain interventions and partnerships to sustainably grow the smallholder dairy sectors of Indonesia and the Philippines (AGB/2021/124)
2. Agribusiness-led inclusive value chain development for smallholder farming systems in the Philippines (AGB/2018/196)
3. Baseline monitoring and evaluation of long-term impacts on fish stocks from coral restoration [Philippines] (FIS/2018/128)
4. Regional coral restoration networks and appropriate technologies for larger-scale coral and fish habitat restoration in the Philippines and Australia (FIS/2019/123)
5. Institutional effectiveness and political economy of coral reef restoration in the Philippines (FIS/2021/112)
6. Increasing technical skills supporting community-based sea cucumber production in Vietnam and the Philippines (FIS/2016/122)
7. An integrated management response to the spread of *Fusarium* wilt of banana in South-East Asia [Indonesia, Laos, Philippines] (HORT/2018/192)
8. Development of area-wide management approaches for fruit flies in mango for Indonesia, Philippines, Australia and the Asia-Pacific region (HORT/2015/042)
9. Developing vegetable value chains to meet evolving market expectations in the Philippines (HORT/2016/188)
10. Improving mango crop management in Cambodia, the Philippines and Australia to meet market expectations (HORT/2016/190)
11. Livestock enhancement through EcoHealth/One Health assessment in South-East Asia (ACIAR–IRDC One Health Research Program) [Indonesia, Laos, Philippines] (LS/2022/163)
12. Policy support to the Philippines' national surveillance and control programs for African swine fever, avian influenza and antimicrobial resistance: A One Health systems approach (ACIAR–IRDC One Health Research Program) (LS/2022/162)
13. Enhancing livelihoods through forest and landscape restoration [Philippines] (ASEM/2016/103)
14. Land management of diverse rubber-based systems in the southern Philippines (SLAM/2017/040)
15. Managing heavy metals and soil contaminants in vegetable production to ensure food safety and environmental health in the Philippines (SLAM/2020/117)

Timor-Leste

A$1.98 million
Budgeted funding

5
Bilateral and regional research projects

1
Small projects and activities

Before the COVID-19 pandemic, food systems in Timor-Leste were already under stress from many factors, including seasonally recurring food shortages, input supply challenges, low productivity, pests and diseases, and limited access to capital. As the situation is now stabilising, ACIAR will establish a new long-term partnership with Timor-Leste to help develop the research system for the benefit for the rural poor. The partnership will be strengthened by the opening of an ACIAR Country Office in Dili, in mid-2022.

While Timor-Leste has made strong progress in recent years, some development indicators remain stubbornly entrenched. With 70% of the population living in rural areas, there is a heavy reliance on incomes from semi-subsistence and seasonal food cropping, mixed with small-scale animal husbandry and varying degrees of foraging for wild crops and game. Despite many recent improvements in a range of essential services, there is a high prevalence of poverty, with more than 50% of the population facing some level of food and food nutritional insecurity. Improving productivity, diversity and returns from agriculture, livestock and fisheries, as well as the functioning of food systems, will remain crucial to overcoming these challenges, with the aim for rural populations to generate sufficient reliable income from agriculture to improve their living conditions and livelihood opportunities.

The reasons for constrained on-farm crop and animal production and productivity are complex and varied. They include highly variable weather conditions affecting crop establishment and subsequent yields, infertile soils, limited availability of and access to agricultural inputs (especially given a weak private sector), low capital for investment, pests and insects causing crop losses pre-harvest and post-harvest, labour constraints at critical times and limited market demand for agricultural products beyond local consumption. Critically, lack of access to credible, locally relevant and implementable science-based advice is a key constraint cutting across all areas.

Country priorities

Since 2001, ACIAR has had a strong program of projects in Timor-Leste, some of which have been long-term (such as Seeds of Life). The time is now right to pivot our relationship to one based on a research partnership between the two countries, not just a series of projects. To achieve this, ACIAR has opened a country office in Dili and during 2022–23 will work with key partners in Timor-Leste to establish the basis of the new and long-term partnership, using as a starting point the analysis of food systems vulnerabilities published in November 2020. This identified opportunities for future research to contribute to the greater resilience of Timor-Leste food systems, including:

- improved social protection measures for vulnerable households
- a renewed focus on the productivity of smallholder agriculture with gradual intensification and improved feed and biosecurity regimes
- greater efforts to expand private sector market developments and increase employment
- greater focus on education and relevant technical training to increase the availability of skilled graduates.

The opportunities for ACIAR to support these priorities will be investigated in more detail this year. Focus sectoral areas may include research in coastal fisheries, agroforestry, livestock (especially cattle and poultry) and cropping systems, as well as seeking opportunities for trilateral research collaboration with Indonesia.

2022–23 research program

- **6 ACIAR-supported projects in Timor-Leste**
- **4 projects are specific to this country**
- **2 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Timor-Leste. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Crops

Many rural households in Timor-Leste do not generate sufficient reliable income from agriculture to improve the living conditions and livelihood opportunities of their families. A new project, led by Associate Professor Louise Barton of the University of Western Australia, will build on previous ACIAR-funded projects to improve productivity of agricultural systems by introducing accessible technologies and improved agronomic practices to overcome soil-related constraints and increase opportunities for diversification and intensification. At the core of the project is capacity development of in-country partners in research practice, research management and agronomic extension services, as well as the development and implementation of business models supporting biochar. The assessment of the viability of sandalwood for smallholders in Timor-Leste will continue, including making recommendations related to barriers to recognising the value of this asset.[1]

The ACIAR program in Timor-Leste will identify opportunities to contribute to the resilience of food systems, such as gradual intensification and improved biosecurity of smallholder agriculture, and greater efforts to expand private sector markets.

Fisheries

Globally, growing momentum for nutrition-sensitive agricultural policy and development assistance is yet to have any impact on the small-scale artisanal fishery sector. To address this, the role and contribution of fish to livelihoods and nutrition security must be supported by rigorous data and communicated at global, national and local scales. A project in Timor-Leste and the East Nusa Tenggara province of Indonesia aims to identify the livelihood and nutrition benefits of fisheries and test nutrition-sensitive co-management systems for inshore fisheries. Led by Dr David Mills of the WorldFish Center, the project will evaluate the nutritional value of fisheries to households, identify the factors enabling or limiting fish consumption, and highlight the potential of fish to reduce malnutrition, particularly during early childhood. In 2022–23 activities will include data collection to understand household livelihood structures and decision-making and community training in healthy diets and child nutrition.[2]

Fish-based livelihoods play a critical role in the economies of coastal communities in Solomon Islands and Timor-Leste, and participation in catching, processing or trading of fish is an important pathway to poverty reduction. A project led by Dr Hampus Eriksson of the University of Wollongong will identify and support community-identified opportunities for innovation within the coastal fisheries post-harvest sector, focusing on income benefits. This new approach addresses the historic lack of success at the community level of large state-led investments in fisheries sector infrastructure and advanced technologies. It seeks to influence policy on how fisheries institutions can support remote communities through appropriate community-led infrastructure and skill development investments. In 2022–23 activities will include monitoring fish distribution and marketing, documenting livelihood experiences and building the capacity of women in safe aquatic food handling practices.[3]

Livestock Systems

There is a growing body of evidence highlighting a causal linkage between foodborne illness due to enteric bacterial infections and malnutrition. Children exposed to damaging enteropathies at an early age may have little chance at realising their full development potential, despite improved diets later in life. Studies in Timor-Leste highlighted the need to better consider the role of food safety in food systems thinking, particularly in the Pacific region where increased consumption of animal-source protein is promoted to address childhood malnutrition and stunting. A new project led by Dr Samantha Colquhoun of the Australian National University, will investigate infant and child dietary practices, food safety and environmental hygiene in relation to community poultry production, with a focus on the risk of *Campylobacter* and *Salmonella* infection. The research will be supported by targeted interventions in urban and rural settings through a One Health approach.[4]

A new project will be established in Timor-Leste during 2022–23, as part of the ACIAR–IDRC Research Program on One Health. Led by the Menzies School of Health Research, the project aims to develop strategies to reduce brucellosis transmission in Timor-Leste based on One Health collaboration (page 24).[5]

Soil and Land Management

A small research activity led by Dr Leigh Vial of Charles Darwin University forms the first stage of a planned large-scale project to improve smallholder farm and livelihood productivity in Timor-Leste. The research will provide an understanding of the biophysical and socioeconomic characteristics of the prospective areas for further targeted research, including an assessment of food security and sovereignty, relevant technical assistance histories, current development status and outlook of each location. These indicators will inform the future design, development and implementation of interventions, technologies and initiatives aimed at lifting rural productivity and resilience in ways that align with expressed community interests.[6]

Country Manager, Vietnam
Mr Luis de Almeida

Research Program Managers
Crops: Dr Eric Huttner
Fisheries: Prof Ann Fleming
Livestock Systems: Dr Anna Okello
Soil and Land Management: Dr James Quilty

See page 186 for contact details.

Current and proposed projects

1. Agricultural Innovations for Communities - Intensified and Diverse Farming Systems for Timor-Leste (AI-Comm 2) (CROP/2021/131)
2. A nutrition-sensitive approach to fisheries management and development in Timor-Leste and Nusa Tenggara Timur Province, Indonesia (FIS/2017/032)
3. Innovating fish-based livelihoods in the community economies of Timor-Leste and Solomon Islands (FIS/2019/124)
4. Bacterial enteropathy and nutrition study in poultry [Timor-Leste] (LS/2021/126)
5. Developing strategies to reduce brucellosis transmission in Timor-Leste based on One Health collaboration (ACIAR–IRDC One Health Research Program) (LS/2022/161)
6. Evaluation of livelihood zones, rural household trajectories, research and development partners and initiatives in Timor-Leste (SLAM/2021/108)

Vietnam

A$5.02 million
Budgeted funding

18
Bilateral and regional research projects

7
Small projects and activities

The Vietnam agriculture sector gained an impressive annual growth rate of 2.9% in 2021, higher than the economy's overall growth of 2.6%. Vietnam has set high ambitions and a strong vision for its agricultural development, but obstacles to reaching those targets remain.

In 2021, the COVID-19 pandemic severely impacted all socio-economic aspects of Vietnam. While many sectors experienced disruptions and adverse outcomes, agricultural production continued to maintain and actively contribute to the country's stability and food security. It also contributed impressively to export revenue and proved to be one of the strongest pillars of the economy.

Vietnam has a stated ambition to become a country with world-class agriculture, prosperous rural areas, modern infrastructure, efficient use and sustainable protection of agricultural resources, and resilience to climate change. In agriculture specifically, Vietnam aims to be in the top 15 agricultural developed countries and rank tenth in agricultural processing technology by 2030. To achieve these goals, Vietnam has prioritised focusing on export commodities that meet good agricultural practices and other quality standards and by value-adding to products through new technologies.

In February 2022, Vietnam launched a national strategy for sustainable agriculture and rural development, Vietnam Issues Green Growth Strategy 2021–2030 Vision to 2050. The Strategy is an important policy document for Vietnam's economic growth and sustainable development, with specific goals related to reducing greenhouse gas emissions. The plan aims to retain forest cover at 43% and apply advanced water-saving irrigation methods to at least 60% of the total irrigated dry crop area. At COP26, Vietnam committed to a 30% reduction in methane emissions by 2030. This will translate directly into options to reduce methane emissions from rice production and livestock and opportunities for carbon storage in forestry, agroforestry and soils.

The strategy also maps out foundations for re-organising production to further develop agriculture and rural areas and increase climate change resilience in the sector. By 2050 Vietnam is expected to have a modern, efficient and environmentally friendly agriculture and developed rural areas with residents' living conditions and incomes matching those of the urban area.

One Health is an area of increasing interest involving agriculture in Vietnam. Vietnam's One Health Partnership framework for zoonoses, for the 2021–25 period, aims to minimise the risk that zoonotic pathogens and environmental agents will cross species barriers and reduce the occurrence of antimicrobial resistance in human and animal pathogens by improving multi-sectoral One Health collaboration in Vietnam.

Within that context, Vietnam sees research-for-development (especially the application of 4.0 technology) as the key to achieving its ambitions to improve efficiency and productivity and increase the competitiveness of agricultural products. Research for rural development continues to be vital, especially linking poorer rural areas to exports. The main challenges to achieving these ambitions in the coming years remain to be climate change, water shortage, soil degradation, lack of market access for agricultural produce and development gaps of ethnic minorities and women in rural areas.

Country priorities

ACIAR has sustained a program of research collaboration with Vietnam for the past 28 years. The strategy for research collaboration between Vietnam and ACIAR from 2017 to 2027 was developed on the basis of mutual acknowledgment that the relationship between ACIAR and Vietnam has evolved from donor–recipient to partnership, co-investment and, possibly, through this period, to trilateral collaboration. The strategy confirms the desire of both parties to join with the private sector wherever possible to create opportunities for poorer residents in rural and urban areas through inclusive agribusiness systems. It also focuses on transformational opportunities for women in research and agribusiness systems and on farms.

The key ambitions of the strategy are to:

- improve the capacity of Vietnamese researchers, research managers and development partners to support sustainable and equitable farming and livelihood systems in the Mekong River Delta, Central Highlands and Northwest regions and in the fisheries and aquaculture sector
- improve the skills, livelihoods and incomes of smallholder farmers, including ethnic minorities in the mountainous areas of the Central Highlands and Northwest regions, supported by knowledge networks that allow profitable engagement in domestic and international markets
- improve human health and nutrition through research on integrated farming systems, nutrition-sensitive agriculture and One Health
- improve the quality and safety of meat, fish, vegetables and fruit for domestic consumption
- develop a deeper knowledge of markets to help prevent and reduce economic shocks for participants in agricultural supply chains
- reduce inputs of chemicals and fertiliser for a cleaner environment, safer produce, improved soil health and more-profitable sustainable production systems
- improve resource use efficiency to produce more food with fewer resources
- implement practices and inform policymakers to manage climate-change impacts on agriculture.

In June 2022, Vietnam and ACIAR reaffirmed these priorities as being the key focus for our partnership. We also reaffirmed the commitment to:

- co-fund 75% of projects during the 10-year period
- develop research into climate change, especially drought-tolerant cropping systems in the Mekong River Delta and the Central Highlands, and saline-cropping systems for the Mekong River Delta.

2022–23 research program

- **25 ACIAR-supported projects in Vietnam**
- **13 projects are specific to this country**
- **12 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Vietnam. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

The strategy for research collaboration between Vietnam and ACIAR (2017–27) is based on partnership and co-investment, the intention to partner with the private sector wherever possible to create opportunities for poorer residents in rural and urban areas through inclusive agribusiness systems.

Agribusiness

Cassava witches' broom disease and Sri Lanka cassava mosaic virus are spreading rapidly in South-East Asia. A project led by Dr Jonathan Newby of the International Center for Tropical Agriculture is developing technically viable and economically and socially sustainable ways to improve the resilience of cassava production systems and value chains in Cambodia, Laos, Myanmar and Vietnam. The project will conclude in 2023 with researchers continuing on-farm testing of new agronomic practices and training of farmers and extension officers. The project team will also finalise their investigation of alternative models for public-private funding for core activities.[1]

Catfish (*Pangasius* sp) farming and wild-caught catfish are important income generating activities for smallholder farmers in the Mekong River Basin and are a vital source of dietary protein for those countries' populations. The continued availability of catfish for human consumption is influenced by many factors including climate change, the COVID-19 pandemic, consumer perceptions on food and health safety provenance, and environmental and political changes. Dr Van Kien Nguyen of the Health and Agricultural Policy Research Institute leads a new project in Cambodia, Laos and Vietnam to identify food loss and waste along the catfish value chain; conduct foresight exercises to determine the uncertainties of catfish production for food systems; and develop solutions to reduce food loss in catfish production. This project is part of the ACIAR–IDRC Food Loss Research Program (page 24).[2]

Smallholder farmers in South-East Asia often cannot access credit to invest in new crops or technologies, deal with risks and shocks, and safely carry wealth from harvest to planting. To help smallholders reach their production potential, a project led by Dr Alan de Brauw of the International Food Policy Research Institute aims to increase knowledge about how to design and implement innovative and inclusive agricultural value chain financing models in South-East Asia. During 2022–23, the project will analyse data to determine the impact of the project in each country and produce initial scientific reports and policy papers.[3]

Unmanaged expansion of coffee and pepper production in the Central Highlands region has resulted in deforestation and production on unsuitable land. Increasingly, the region is subject to the impacts of climate change, with increasing temperatures and erratic rains. There has also been misuse and overuse of mineral fertilisers, irrigation water and synthetic pesticides. A project led by Dr Estelle Bienabe of the World Agroforestry Centre aims to enhance smallholder livelihoods, including vulnerable populations, by improving the sustainability of coffee and black pepper farming systems and value chains. In 2022–23, researchers will evaluate integrated farming practices in on-farm trials to inform farming system design, initiate simple practice changes, and assess barriers to adopting recommended good farming practices.[4]

About 1.5 million smallholder farmers in the Mekong River Delta region rely on rice for their livelihood. Rice is grown on small farms, with 2 or 3 crops produced each year. The industry faces issues such as reduced returns to farmers, soil degradation, environmental pollution and declining seed purity and grain quality. In 2017, the Government of Vietnam developed a policy to encourage reduced total rice production and a focus on high quality, with the aim of exporting to premium markets. A new 4-year project, led by Dr Jaquie Mitchell of the University of Queensland, aims to establish a highly productive, sustainable, traceable and quality-assured value chain for tropical medium-grain rice in the Mekong River Delta for the benefit of rice-farming households and to meet established market requirements of the partnering global marketer. The project is a public private partnership, co-funded by ACIAR and Ricegrowers Limited, an Australian company operating a recently refurbished state-of-the-art rice mill in the Mekong Delta and global markets for higher value specialty rice products.[5]

A new project led by Dr Stephen Ives of the University of Tasmania will investigate new collaborative approaches between smallholder farming households and commercial intensive agricultural systems with a focus on beef supply chains. The project aims to establish and pilot best practice smallholder inclusive business models based on these new approaches. These new approaches and business models will be mutually beneficial, enabling improved livelihoods for smallholder farming households and improved productivity and performance for commercial supply chains in Vietnam.[6]

Previous ACIAR-funded projects helped establish a new safe vegetable industry in the Son La province of Northwest Vietnam, worth A$70 million per year. The new value chain follows the VietGAP quality assurance protocol and supplies a range of vegetables to modern retail and traditional markets, mainly in Hanoi. However, challenges remain along the value, the most significant being traceability, compliance with VietGAP and product quality. A small research activity, led by Dr Gordon Rogers of Applied Horticultural Research, will develop and pilot low-cost digital tools (such as QR codes, temperature sensors and GPS locators) to help small and medium-sized vegetable farmers, and other value chain participants, to improve VietGAP compliance and manage the quality and safety of vegetables delivered to market.[7]

Climate Change

Australia is a world leader in greenhouse gas mitigation research in agriculture. This project assists Vietnam in strengthening its national greenhouse gas accounting systems to identify, quantify and report on rice management options that reduce emissions. Led by Professor Peter Grace of Queensland University of Technology, the project team will work with government institutions in Vietnam and will help grow capability in the data management, analyses, reporting and cross-Ministerial governance needed to support current and future emissions reduction commitments under the Paris Agreement. The team will also collaborate with a number of others who are working to support development of Vietnam's greenhouse gas inventory systems.[8]

The impact of climate change on the Mekong River Delta's coastal areas is such that current food production systems, particularly shrimp aquaculture, are already unsustainable and increasingly at risk. Mangrove poly-culture systems have the potential to provide a large-scale alternative, expanding inland as sea-level rise and extensive inundation with sea water increase. They can also contribute to carbon sequestration and support the national government's priorities for growing modern agribusinesses in the delta region. Led by Dr Pham Thu Thuy of CIFOR, in collaboration with Can Tho University and CSIRO, a new project will work alongside existing restoration efforts, building the capacity of farmers, governments and development partners to maximise the success of current mangrove-based food production and co-developing pathways for a more transformative approach linked to agri-business development.[9]

Fisheries

Floodplain development and the regulation of river flows for rice production across South-East Asia are affecting fisheries and fish migration, and the livelihoods of communities that depend on fish for protein and trade. Previous ACIAR-supported research showed that integrating fishways into water regulator designs, allowing passage of migratory fish up and down regulated rivers, can have lasting economic and social benefits for river communities. Professor Lee Baumgartner of Charles Sturt University leads a project to establish a stakeholder network to facilitate sound, cross-sector decision-making on fish passage construction programs across South-East Asia. During 2022–23, researchers will continue gathering data on fish migration and undertake an international review of draft guidelines and curriculum for a specially designed Graduate Certificate in Fisheries. An additional DFAT investment aims to broaden the projects outcomes to include scaling of fish passage technologies across Mekong countries.[10]

Dried sea cucumbers are highly valued in markets across China and South-East Asia. Overfishing and poor fisheries management throughout the Asia-Pacific region have resulted in serious declines of sea cucumber stocks and even led to fishery closures, reducing income-generating opportunities for coastal communities. A project led by Professor Paul Southgate of the University of the Sunshine Coast is developing culture methods that support pond-based sea cucumber farming in Vietnam and sea-based farming in the Philippines. In 2022–23 activities will include assessing potential predator mitigation measures, continuing field experiments and developing protocols for the responsible use and transfer of sandfish.[11]

Australia's Commission for International Research and Policy Advisory Council, and ACIAR staff visited a mangrove area in Soc Trang province during their in-country annual meeting in Vietnam, June 2022, to view mangrove poly-culture systems, which are potentially a large-scale alternative to traditional shrimp aquaculture systems that are increasingly at risk to the impacts of climate change. Photo: Patrick Cape

Marine bivalves, such as mussels, clams and oysters, are known to sequester carbon in their shells. There is interest in the potential for bivalves to mitigate the effects of climate change. In northern Vietnam, a small research activity led by Dr Sarah Ugalde of the University of Tasmania examines the role of the Portuguese oyster (*Crassostrea angulata*) aquaculture industry in the carbon cycle and rates of carbon sequestration. This new information will be used to evaluate the potential value for oyster carbon farming to reduce climate-change impacts through shell recycling and value-adding, including using carbon crediting mechanisms.[12]

Hybrid grouper farming is Vietnam's most profitable marine fish aquaculture sector, involving over 400 hatchery operators and grow-out farmers. The Directorate of Fisheries aims to increase small and medium enterprises in marine aquaculture, but the hybrid grouper sector is constrained by its reliance on a nutritionally poor and variable supply of 'trash' fish. Farmers report they are willing to use more sustainable, cost-effective formulated feeds, but a lack of data on suitable feed formulations has constrained development. A project funded by DFAT and led by Dr Leo Nankervis of James Cook University will deliver nutritional data required to formulate cost-effective feeds that promote superior growth and survival and so attract smallholder farmers to switch to formulated feeds. Cooperation with large feed mills in Vietnam's private sector will support the local supply of cost-effective diets for hybrid grouper and underpin broad-scale adoption of commercial pelleted feeds.[13]

A project funded by DFAT and led by James Cook University is determining the nutritional data required to formulate cost-effective feeds for hybrid groupers to promote superior growth and survival. Photo: Khanh Long

Unique among Pacific island countries is the production of half-pearls, or mabé, in Tonga from the winged pearl oyster. Although half-pearls are generally less valuable than round pearls, an individual oyster can produce multiple half-pearls (unlike round pearls). With appropriate training, pearl production can be accomplished by community members over a 10-month culture period, compared to approximately 2 years for round pearls. Professor Paul Southgate of the University of the Sunshine Coast completes a project in 2023 that is supporting further expansion of community-based pearl farming and handicraft production in Tonga and demonstrating the feasibility of similar development in Vietnam.[14]

Forestry

A project with activities in Indonesia and Vietnam will underpin good plant biosecurity practices in forestry. Led by Dr Caroline Mohammed of the University of Tasmania, researchers will work with government and industry partners to extend screening approaches developed for the fungus *Ceratocystis* in acacia to eucalypts, which have replaced acacias in plantations in areas of the wet tropics. Researchers will develop remote-sensing software applications for cheap and rapid forest health surveillance and, through geospatial modelling, deliver risk maps under current and future climates at a regional level for the highest-priority pests and pathogens. In 2022–23 activities will include building the capacity of local partners to access climate data and run distribution models, and identifying eucalypt parents for hybridisation.[15]

Northwest Vietnam is among Vietnam's poorest regions. It is mountainous, deforested and severely eroded. A project led by Associate Professor Doland Nichols of Southern Cross University will increase tree cover in Muong La District by developing a farmers' cooperative nursery producing and selling fruit and timber trees and subsidising members' tree planting. A linked silvics experiment in Muong La Nature Reserve will use farmer-produced seedlings to provide knowledge responsive to the Vietnamese Government's directive to develop climate-resilient, native timber production for its processing industries. Both activities will provide research training for Tay Bac University faculty and students and contribute to post-flood local restoration.[16]

Increased trade, global movement and a changing climate increase the threat of emerging pests and diseases. The capability to detect and respond to forest pest and disease incursions is crucial to minimising their impacts. In South-East Asia, this capacity varies widely, but there is a general lack of preparedness. A project co-led by Dr Madaline Healey and Associate Professor Simon Lawson of the University of the Sunshine Coast will establish an effective and sustainable forest biosecurity network to improve risk management for invasive forest pests and diseases. The project will use shared field protocols and data as an entry point and foundation for coordinated biosecurity response. In 2022–23 activities will include launching resources to assist with in-country identification of pests and pathogens and delivering biosecurity awareness training.[17]

Livestock Systems

Poultry enterprises offer opportunities to improve the nutrition of households and economically empower women, who are the key custodians of smallholder poultry in South-East Asia. However, low-producing chicken genotypes typically dominate smallholder or family production systems. Dr Tadelle Dessie of the International Livestock Research Institute leads a project to test and make available high-producing, farmer-preferred genotypes of chickens to increase smallholder productivity as a pathway out of poverty in Cambodia and Vietnam. During 2022–23, the project continues activities to quantify smallholder chicken production systems and investigate promising breeds for the region. The project is also designing a breed improvement program in Cambodia.[18]

Goat production in Laos has more than doubled over the past 10 years, largely driven by high demand for goat meat from Vietnam. Traditional extensive goat-raising methods can result in overgrazing of feed resources, negative consequences for the environment and higher incidence of diseases and parasites in livestock. A project led by Professor Stephen Walkden-Brown of the University of New England is aiming to enhance income-generating opportunities for goats in Lao farming systems, while identifying sustainable production practices. Additionally, the project is seeking greater understanding of consumer preferences for goats in Vietnam to further develop market specifications, especially for premium meat. During 2022–23, the project will develop performance benchmarks and define best practice for smallholders, larger goat farmers and agroforestry systems. The project will also conduct market surveys to ascertain past, current and likely future demand for goats and goat meat, and factors affecting pricing and demand.[19]

Market demand for beef is increasing rapidly in Vietnam, outstripping current levels of domestic production. A project led by Dr Stephen Ives of the University of Tasmania is investigating and implementing whole-farm solutions for smallholder cattle producers in the highlands of Northwest Vietnam. This will help smallholder farmers shift from extensive to more-intensive production systems so they can meet market specifications, increase market linkages and improve profitability. In 2022, project will complete capacity building activities for stakeholders in the beef value chain, including key advisory and extension staff, and design an up-scaling strategy for a sustainable crop-livestock system.[20]

A review of key thematic areas of animal health governance considered regulation, the veterinary workforce, ethics and welfare, surveillance, innovation, biosecurity, trans-boundary trade and service delivery. The review found that significant gaps existed in knowledge and engagement, especially when compared to the human health sector. Dr Kevin Bardosh leads a project to address recommendations from the review to strengthen and support the animal health sector in low and middle-income countries. The recommendations include establishing and convening a network of social and political scientists working on animal health governance; and conducting a systematic review of the social and political science literature in the global animal health field.[21]

A project led by the University of Tasmania is investigating and implementing whole-farm solutions for smallholder cattle producers in the highlands of Northwest Vietnam to shift from extensive to more-intensive production systems, to meet rapidly growing market demand and specifications, increase market linkages and improve profitability. Photo: Vu Khanh Long

Social Systems

A small research activity will report on its analysis of gender transformative tools designed to support ethnic minorities in the Technologically Enhanced Agricultural Livelihoods (2018–2022) project operated by CARE International in the northern uplands of Vietnam. The project, led by Dr Rochelle Spencer of Murdoch University, determined how the tools contribute to changing gender relations and empowering women, and to what extent. The project will complete training of in-country partners and 10 early-career social science researchers in mixed-method research, including participatory methods and project-level Women's Empowerment in Agriculture Index.[22]

Soil and Land Management

Strong market demand for concentrated livestock feeds to support livestock industries resulted in a maize boom in Vietnam and Laos and a rapid shift to annual cropping. Fluctuations in maize price, soil erosion and declining soil fertility have pressured governments and communities into looking for alternative land use options. A small research activity led by Professor Michael Bell of the University of Queensland proposes to use an established network of researchers, extension agents and traders as the basis for developing a Theory of Change focused on maize production areas in Vietnam and Laos. It will explore opportunities to link institutional research and private sector development capacity in these regions to stimulate and support the development of economically and environmentally sustainable, climate change resilient agricultural systems.[23]

Increasing numbers of smallholder farmers in Laos and northern Vietnam are growing maize on sloping land to meet demand for livestock feeds by poultry, pig and cattle industries in China and South-East Asia. A project led by Professor Michael Bell of the University of Queensland is helping farmers adopt maize-based farming systems that reduce soil degradation and improve smallholder livelihoods and economic viability. The project concludes in 2022 with the delivery of outreach models to support the adoption of more diversified maize-based farming systems and bioeconomic frameworks to structure the assessment of the sustainability and productivity of different crop and forage options.[24]

Sea-level rise and changes to seasonal rainfall patterns due to climate change result in decreased freshwater availability and higher saline intrusion of the Mekong River Delta during the dry season. To maintain productivity and profitability, farmers require better soil-management techniques and profitable alternative crops to grow in the dry season. A project led by Dr Jason Condon of Charles Sturt University is providing evidence-based options for profitable crop diversification in the rice production areas of the Mekong River Delta. The project aims to increase production and profitability through diversification of saline-affected rice-based cropping systems and create a capacity legacy to enable these systems to adapt to ongoing climate change.[25]

ACIAR Research Program Manager, Soil and Land Management, Dr James Quilty (right), inspects salinity affected soil in the Mekong Delta region of Vietnam with local soil experts Quach Kim Hoa (left) from the Soc Trang Provincial Department for Agriculture and Rural Development, and Dr Chau Minh Khoi (middle) the ACIAR Country Coordinator from Can Tho University. Photo: Patrick Cape

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See page 186 for contact details.

Current and proposed projects

1. Establishing sustainable solutions to cassava diseases in mainland South-East Asia [Cambodia, Laos, Myanmar, Vietnam] (AGB/2018/172)
2. Food loss in the *Pangasius* catfish value chain of the Mekong River Basin (Food Loss Program) [Cambodia, Laos, Vietnam] (CS/2020/209)
3. Inclusive agriculture value chain financing [Indonesia, Myanmar, Vietnam] (AGB/2016/163)
4. Increasing the sustainability, productivity and economic value of coffee and black pepper farming systems and value chains in the Central Highlands region of Vietnam (AGB/2018/175)
5. Planning and establishing a sustainable (SRP) smallholder rice chain in the Mekong Delta [Vietnam] (AGB/2019/153)
6. Integrating smallholder households and farm production systems into commercial beef supply chains in Vietnam (AGB/2020/189)
7. Piloting digital monitoring of VietGAP compliance and quality in Vietnam vegetable value chains (AGB/2021/153)
8. Supporting greenhouse gas inventories and targeted rice mitigation options for Vietnam (CLIM/2019/150)
9. Preparing for mangrove-based climate and agribusiness transformation in the Mekong Delta [Vietnam] (CLIM/2021/138)
10. FishTech: Integrating technical fisheries solutions into river development programs across South-East Asia [Cambodia, Indonesia, Laos, Vietnam, Thailand] (FIS/2018/153)
11. Increasing technical skills supporting community-based sea cucumber production in Vietnam and the Philippines (FIS/2016/122)
12. Blue economy: Valuing the carbon sequestration potential in oyster aquaculture [Vietnam] (FIS/2020/175)
13. Supporting grouper farming smallholders in Vietnam to improve their SME businesses by engaging with aquafeed companies to produce commercial feeds [Vietnam] (FIS/2021/121)
14. Half-pearl industry development in Tonga and Vietnam (FIS/2016/126)
15. Managing risk in South-East Asian forest biosecurity [Indonesia, Vietnam] (FST/2018/179)
16. Vietnamese native tree species for improved livelihoods [Vietnam] (FST/2020/134)
17. Building an effective forest health and biosecurity network in South-East Asia [Cambodia, Indonesia, Laos, Vietnam] (FST/2020/123)
18. Asian chicken genetic gains: A platform for exploring, testing, delivering, and improving chickens for enhanced livelihood outcomes in South East Asia [Cambodia, Vietnam] (LS/2019/142)
19. Goat production systems and marketing in Laos and Vietnam (LS/2017/034)
20. Intensification of beef cattle production in upland cropping systems in Northwest Vietnam (LPS/2015/037)
21. Global animal health governance: High-level consortium [Vietnam] (LS/2021/157)
22. Analysing gender transformative approaches to agricultural development with ethnic minority communities in Vietnam (SSS/2018/139)
23. Embedding knowledge and exploring future research opportunities in sloping land agricultural systems in northern Laos and northwest Vietnam (SLAM/2021/152)
24. Improving maize-based farming systems on sloping lands in Vietnam and Laos (SMCN/2014/049)
25. Farmer options for crops under saline conditions (FOCUS) in the Mekong River Delta, Vietnam (SLAM/2018/144)

5.3

South Asia

Photo: Conor Ashleigh

South Asia

South Asia is an immensely diverse and densely populated region. It is home to 1.5 billion people – one-quarter of the world's population. The region has the highest concentration of poor people in the world, with more than 500 million people living in extreme poverty.

Despite the population pressure, the region has shown impressive annual economic growth at an average of 6.7%. However, the COVID-19 pandemic is projected to significantly and negatively impact the region's economic growth, pushing another 71 million people into extreme poverty. Many more people, particularly women, live marginally above the poverty line but do not have the opportunity to participate in the process of economic growth.

Compared with other regions in the world, South Asia has the highest regional Global Hunger Index and a very low Human Development Index. Half of the population depends on agriculture for their livelihood. Although the share of agriculture in rural employment remains high, growth of the rural non-farm sector is accelerating and now provides a sizeable share of rural income and employment, primarily in services.

Malnutrition is prevalent in South Asia. The region has among the highest burdens of child undernutrition in the world. Thirty-six per cent of children under age 5 are stunted, or too short for their age, which is an indicator of chronic undernutrition. Sixteen per cent are wasted, or too thin for their height, which is an indicator of acute malnutrition. South Asia also has a high prevalence of micronutrient deficiencies, overconsumption and diet-related non-communicable disease.

While the countries of South Asia face common challenges and opportunities in agriculture, there are also fundamental differences between and within these countries in terms of the broad characteristics that influence the nature and success of agriculture. India has 15 distinct agroecological zones. Nepal has 3 distinct topographical zones. The northern hilly region of Bangladesh is geographically distinct from the southern coastal areas, mostly alluvial, with fertile floodplains associated with 3 major rivers. Pakistan's Indus plains are in sharp contrast to the arid regions of Sindh and the hilly and semi-arid areas of the north-west. Sri Lanka's landscape is clearly defined by its dry and wet zones. These regional variations throughout South Asia must be considered when designing a meaningful program for research collaboration to accommodate regional distinctions and varying degrees of vulnerability of the local population.

According to the International Food Policy Research Institute's 2021 Global food policy report: Transforming food systems after COVID-19, South Asia faces continuing and, in some cases, intensifying problems related to climate change, natural disasters, poor food safety and distortionary policies. Fall armyworm devastated Afghanistan, Pakistan and parts of India and Nepal in 2020. Bangladesh and India struggled with flooding during the pandemic, and bird flu caused a nationwide food-safety scare in India. Distortionary policies, and the increasing costs of implementing them, remain, despite overwhelming evidence of their negative impacts and the potential to repurpose these much-needed resources for climate-smart investments or to build robust food-safety institutions. A perplexing reality remains the relatively low volume of agricultural trade among the countries of South Asia.

Given the high population densities and large numbers of vulnerable people, the COVID-19 pandemic has been a huge challenge for South Asia. Agriculture is highly dependent on informal labour, which has been severely limited during lockdowns and restricted by social distancing measures. These were all disruptive factors for supply chains and agriculture markets.

India aims to export a record 10 million tonnes of wheat in 2022–23 amid rising global demand exacerbated by the Ukraine crisis, which will impact buffer stocks and pricing and threaten the region's food security, significantly impacting low-income groups.

Partner countries in the South Asia region

- Bangladesh
- India
- Nepal
- Pakistan
- Sri Lanka

Drivers of regional collaboration

Countries in South Asia share many opportunities and threats that drive the need for regional cooperation, especially in the Eastern Gangetic Plains. Rice and wheat are the region's major staple crops, accounting for about two-thirds of total dietary energy. However, food consumption patterns have changed in the region over the past few decades, and the changes are most apparent in rural areas. Consumption of cereals is declining while consumption of animal-sourced foods, fruits, vegetables and processed foods is increasing.

Pressure to expand food production to meet growing demand is putting stress on natural resources. The resulting expansion and intensification of agriculture is leading to land degradation, deterioration of soil quality and loss of biodiversity, potentially jeopardising the region's capacity to meet future food demand.

Agricultural growth also poses risks for water resources. Facing the world's lowest per capita renewable freshwater resources, millions of rural people in South Asia have benefited from the growing use of groundwater. But aquifers are being depleted and, across the region, watertables are falling, particularly in India. Water quality is also deteriorating throughout the region due to nutrient overloads and industrial pollution, raising concerns about food safety and drinking water quality.

Large areas in several countries of South Asia are prone to natural disasters. Bangladesh and coastal parts of India are threatened frequently by cyclones and floods. Recurring droughts are a common feature in the arid and semi-arid parts of India and Pakistan. The impact of natural calamities is most severe on food-insecure households.

Climate variability, competing and increasing demands from agriculture and industry (including energy production) and population growth are creating severe demands on water availability. Regional cooperation is increasingly essential to manage these shared resources and address shared issues. There are also significant opportunities in regional cooperation to improve the productivity and diversification of agricultural crops, especially beyond cereals, and to improve the sustainability of farming systems through technical, institutional, value-chain and policy research and development.

Sri Lanka is witnessing one of the worst economic and political crises in its history, and the Ukraine crisis has further amplified uncertainty in the region, with oil and fertiliser prices rising.

ACIAR South Asia region program

Australian agricultural and resource management expertise is highly regarded in the South Asia region. ACIAR has a long history of research collaboration in improving crop productivity, forestry, water use efficiency and policy reforms. The South Asia regional program of the Australian Government seeks to underpin Australia's economic engagement in the region by addressing some of the key regionwide barriers to sustainable economic growth and connectivity. Gender equality is a focus in all the investments under the regional program.

The ACIAR strategy in South Asia focuses on communities, production systems and resource management in the 3 main ecosystems of the region – highlands, plains and coastal areas – that are common to Pakistan, India, Bangladesh, Nepal and Sri Lanka.

Research in these areas looks to identify appropriate reform policy, increase adoption of technology (including post-harvest management), improve productivity and livelihoods in marginalised communities, and improve the productivity of crop, livestock, forestry and fisheries systems.

The major pathways of development in the region are modernisation of agrifood systems, technology support, strengthening service providers, developing rural non-farm sector, and local governance at district and state level. Overproduction in some areas and unequal distribution networks due to poorly developed supply-chain management are the major issues in India. Addressing these could play a major role in achieving food and nutrition security and stability in the region.

The medium to long-term strategy in the region focuses on creating regional collaborations that:

- sustainably intensify and diversify cropping systems using conservation agriculture/zero tillage, farm mechanisation, saline land management and adaptation to climate change
- eradicate extreme poverty through improved productivity of food-grain crops (especially wheat and pulses), livestock (in Pakistan), agroforestry (in Nepal) and fisheries (in Sri Lanka)
- better manage agricultural water, including rainfed areas in the Eastern Gangetic Plains and coastal zone
- influence policy about agricultural and farmers' livelihoods and climate change
- increase the emphasis on meaningful gender inclusion and empowerment.

South Asia region program 2022–23

Partner country	No. projects
Bangladesh	12
India	6
Nepal	3
Pakistan	13
Sri Lanka	2

Note that a project may be conducted in several countries, therefore the total number of projects in this table will be greater than the number of projects in the region.

28 projects

20 research projects

8 small research activities

This data was compiled in August 2022. Additional projects may be commissioned during 2022–23.

Research portfolio

3 Agribusiness projects

3 Climate Change projects

7 Crops projects

1 Fisheries project

1 Forestry project

2 Horticulture projects

0 Livestock Systems projects

0 Social Systems projects

1 Soil and Land Management project

10 Water projects

Table 5.3 Current and proposed projects in the South Asia region, 2022–23

Project title	Project code	Country
Agribusiness		
Developing competitive and inclusive value chains of pulses in Pakistan	ADP/2017/004	Pakistan
Understanding the drivers of successful and inclusive rural regional transformation: Sharing experiences and policy advice in Bangladesh, China, Indonesia and Pakistan	ADP/2017/024	Bangladesh, China, Indonesia, Pakistan
Developing food loss reduction pathways through smart business practices in mango and tomato value chains in Pakistan and Sri Lanka (Food Loss Program)	CS/2020/193	Pakistan, Sri Lanka
Climate Change		
MAC-B: Mitigation adaptation co-benefits modelling trial in Bangladesh	CLIM/2021/109	Bangladesh
Locally led learning to turn polders into flexible assets for adaptation	CLIM/2021/137	Bangladesh
Supporting the tracking sharing learning platform of the Adaptation Research Alliance	CLIM/2022/108	Global
Crops		
Incorporating salt-tolerant wheat and pulses into smallholder farming systems in southern Bangladesh	CIM/2014/076	Bangaladesh
Increasing productivity and profitability of pulse production in cereal based cropping systems in Pakistan	CIM/2015/041	Pakistan
International Mungbean Improvement Network 2	CROP/2019/144	Bangladesh, India, Indonesia, Kenya, Myanmar
Managing wheat blast in Bangladesh: Identification and introgression of wheat blast resistance for rapid varietal development and dissemination	CROP/2020/165	Bangladesh
Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan	CROP/2020/167	Bangladesh, Ethiopia, Pakistan
Intercropping for intensification and diversification in the Eastern Gangetic Plains	CROP/2021/155	Bangladesh, India
Enhancing farm-household management decision-making for increased productivity in the Eastern Gangetic Plains	CSE/2012/108	Bangladesh, India, Nepal
Fisheries		
Improved productivity, efficiency and sustainability of the culture-based fishery for finfish and giant freshwater prawn in Sri Lankan reservoirs	FIS/2018/157	Sri Lanka
Forestry		
Enhancing livelihoods through improved forest management in Nepal	FST/2017/037	Nepal
Horticulture		
Strengthening vegetable value chains in Pakistan for greater community livelihood benefits	HORT/2016/012	Pakistan
Improving smallholder wellbeing through participation in modern value chains: sustaining future growth in the Pakistan citrus industry	HORT/2020/129	Pakistan
Soil and Land Management		
Developing and translating soil health information in Bangladesh with farmers and for farmers to build resilient agricultural systems	SLAM/2021/107	Bangladesh
Water		
Cropping system intensification in the salt-affected coastal zones of Bangladesh and West Bengal, India	LWR/2014/073	Bangladesh, India
Nutrient management for diversified cropping in Bangladesh	LWR/2016/136	Bangladesh
Adapting to salinity in the southern Indus Basin	LWR/2017/027	Pakistan
Water management for smallholder farmers: Outscaling ACIAR research in the Andhra Pradesh Drought Mitigation Program	WAC/2018/164	India
Transforming smallholder food systems in the Eastern Gangetic Plain	WAC/2020/148	Bangladesh, India, Nepal
Opportunities for brackish and saline aquaculture in Pakistan	WAC/2020/179	Pakistan
Virtual Irrigation Academy business models in Pakistan	WAC/2020/180	Pakistan
Supporting inter-provincial water allocation decision making in Pakistan	WAC/2021/103	Pakistan
Groundwater management in Pakistan	WAC/2021/134	Pakistan
Trees for salinity management, Sindh, Pakistan	WAC/2021/136	Pakistan

Bangladesh

A$2.11 million
Budgeted funding

11
Bilateral and regional research projects

2
Small projects and activities

Agriculture plays a pivotal role in the Bangladesh economy and in the lives of the vast majority of the population.

The agriculture sector accounts for more than half of employment in Bangladesh. Notwithstanding its transformation from a country of chronic food shortages to one of net food grain self-sufficiency, Bangladesh still faces very substantial food security challenges. While poverty is steadily declining, many people still live below the poverty line.

Recently, Bangladesh has made impressive progress in achieving national food security. Investments in agricultural research have played a pivotal role in driving productivity increases of major crops. The ongoing challenge is to improve productivity of low-lying areas and rainfed cropping systems and increase rural incomes. This goal is adversely affected by increasing seasonal climate variability, reduced freshwater river flows and seawater intrusion.

Climate change is the most pressing issue for Bangladesh, with varying levels of vulnerability and impacts across the country. Coastal areas are prone to salinity intrusion and tropical cyclones, the floodplains in the central areas are prone to floods, the north-western region is prone to drought, the north-eastern region is prone to flash floods and the hilly regions are prone to erosion and landslides.

Bangladesh is an active participant in the global effort to combat climate change and must develop adequate adaptive capacity to protect its people and economy. In view of the substantial long-term challenges presented by climate change, the government has developed a long-term Bangladesh Delta Plan 2100 that focuses on developing approaches to sustainable management of water, environment and land resources.

The Bangladesh Climate Change Strategy and Action Plan is the de facto policy document that provides strategic direction for work on climate-change related issues. Many elements of climate-change adaptation in the country are also being addressed through specific sectoral policies. Recent consultations highlighted that the consequences of climate change on rural livelihoods is the most pressing issue facing Bangladesh and is likely to drive thinking about future priorities for research collaboration with ACIAR.

Key priorities for Bangladesh (National Agriculture Policy 2018) that align with ACIAR objectives are:

- diversification of crops, including production of high-value crops
- development and promotion of stress-tolerant, disease-resistant and nutritious crop varieties
- improvement of crop production systems for market-oriented agriculture
- building national capacity in innovation
- extension of technologies to increase overall productivity growth and reduce the difference between research farm and field-level yields.

ACIAR supports regional approaches to assisting Bangladesh, including in the areas of natural resource management, improving trade connectivity and encouraging investments to empower women to participate in cross-regional trade opportunities.

Country priorities

Bangladesh has been an ACIAR partner country since the mid-1990s. Over time, the ACIAR program has shifted towards a farming systems approach supporting broader food security aspects, improved production and diversification of the rice-based farming systems, and adaptation to climate change. This approach includes research on short-duration varieties of pulses to fit the farming system, conservation agriculture-based technologies and related mechanisation, saline land management and adaptation to climate change. ACIAR-supported programs in Bangladesh have focused on the undulating lands of the north and north-west regions and the coastal region (which is the poorest and most vulnerable region in the country). Bangladesh's ability to maintain food security given its high vulnerability to the impacts of climate change underpins the priorities for our support.

Key agricultural production challenges are common to many countries of South Asia, and we play a role in strengthening regional research linkages between Bangladesh and other countries, particularly India (Bihar and West Bengal states) and Nepal (eastern Terai region).

Consultation with key research and development stakeholders in Bangladesh and Australia established the ACIAR–Bangladesh Collaboration Strategy 2021–2030 and confirmed the following priorities for research collaboration:

- crop improvement, with a focus on wheat, maize and pulses
- improved farming systems, with a focus on cropping systems and diversification
- water management, with a focus on managing both quantity (scarcity, groundwater and waterlogging) and quality (salinity)
- soil fertility and soil management
- markets, diversification and agricultural value chains
- agricultural mechanisation.

Research will focus on farming systems of north, north-west and coastal Bangladesh.

The Krishi Gobeshona Foundation is a strategic partner and co-investor with ACIAR in Bangladesh. The foundation is an agricultural research funding organisation that has made major investments in funding research and capacity building in ACIAR-supported projects. The partnership with the foundation for collaboration in agriculture research and development in Bangladesh was renewed in January 2021 for 5 years.

2022–23 research program

- **13 ACIAR-supported projects in Bangladesh**
- **6 projects are specific to this country**
- **7 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Bangladesh. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Success in rural transformation is measured not only by income growth in the rural population, but also by the degree of inclusiveness in the society. A project in China, Bangladesh, Indonesia and Pakistan, led by Dr Chunlai Chen of the Australian National University, endeavours to understand the nature and drivers of rural transformation in order to provide better policy advice to underpin the success of transformation. During 2022–23, researchers will analyse and report on the results of their study into the components of success and the different impacts of rural transformation on women and men.[1]

The priorities of the ACIAR research program in Bangladesh focus on supporting the country to maintain food security given its high vulnerability to the impacts of climate change. Photo: Conor Ashleigh

Climate Change

There are many potential agricultural management changes that could help farmers adapt to and mitigate climate change, but the pace of climate response is slow. Co-benefits modelling could help accelerate climate response by allowing more efficient screening of many potential interventions at once and comparing them to identify the most promising subset, including those that also deliver social and economic benefits. The Agricultural Model Intercomparison and Improvement Project (AgMIP) is a global collaborative initiative that has developed such a co-benefits modelling approach. A small research activity led by Dr Jonas Jaegermeyr and Erik Mencos Contreras of Columbia University and colleagues in Bangladesh has been trialling these modelling methods in rice production systems. In the final stages of the project, the researchers will identify climate responses with the greatest potential for multiple benefits and revise and validate the methods for application globally.[2]

In south-west Bangladesh, polders are potentially an important feature of agricultural production systems that could facilitate ongoing learning, adjustment and adaptation to climate change. Polders can be managed in various ways to support different types of agricultural production, but previous research has focused on optimising management for current conditions rather than building local capacity to change management as conditions change, including sea levels, tidal surge and patterns of river flows. Led by Mr T.S. Amjath Babu of CIMMYT with the International Centre for Climate Change and Development as well as Australian agricultural learning systems expert Dr Christine King, a new project will co-develop targeted processes and local governing organisations so that locally led social learning can support adaptive management of polders as baseline climate conditions continue to change.[3]

Crops

In the coastal regions of southern Bangladesh, agriculture centres on the annual cropping of rice in the monsoon season and other crops in the dry (rabi) season. While the system is profitable, it is limited by topography, soil salinity and irrigation availability. A 5-year project led by Professor William Erskine of the University of Western Australia aims to improve productivity and profitability of dry-season cropping on non-saline land, and introduce pulses and wheat with improved salinity tolerance for saline land. Final-year activities for the project include demonstrations of best practice for mungbean, cowpea, garden pea and wheat production, field validation of wheat lines for salinity tolerance, and piloting the deployment of mini-mills to process pulse grains.[4]

Mungbean is an ideal rotation crop for smallholder farmers throughout the Indian Ocean Rim region. The International Mungbean Improvement Network, established through a project led by Dr Ramakrishnan Nair of the World Vegetable Center, helped realise the potential of mungbean to improve cropping system productivity and livelihoods by improving researchers' access to genetic material, and coordinating and providing technical support to variety development in Bangladesh, India, Myanmar and Australia. Phase 2 of the project extends the network to Kenya and Indonesia, expanding the source of germplasm to develop new mungbean varieties, as well as strengthening the capacity of more national mungbean breeding programs.[5]

Hybrid wheat has the potential to produce more grain from the same or less land, significantly contributing to food security and land sustainability. However, technical difficulties of hybrid wheat development and the high cost of hybrid seed have constrained the commercial development of new varieties for many decades. Professor Richard Trethowan of the University of Sydney leads a project that aims to extend the benefits of new hybrid wheat systems to researchers, wheat breeders, farmers and consumers in Pakistan, Bangladesh and Ethiopia. The university has developed a novel, cost-effective and practical system to rapidly produce large numbers of wheat hybrid combinations for testing in breeding programs, and to produce large amounts of hybrid seed for sale to farmers at an acceptable cost. The project will establish the performance of the hybrids, and determine effective technical processes and business models to produce the seed in collaboration with the national programs and local seed providers in each country.[6]

Wheat blast is a fungal disease now established in Bangladesh which continues to threaten crops throughout South Asia. A large-scale epidemic is inevitable in conducive conditions, and this will have a large impact on wheat production and food security in the region. Dr Pawan Kumar Singh of CIMMYT leads an ACIAR-funded project to support the operation of the wheat blast screening platform established under a previous ACIAR project. The platform is operated in Jashore by Bangladesh researchers, with support from CIMMYT, and is being used by the global wheat research community. The new project will identify new sources of resistance to wheat blast by continuing to support the platform, map the resistance genes, facilitate the rapid breeding of elite varieties for Bangladesh farmers, and document adoption by farmers of new varieties resistant to wheat blast.[7]

The practice of intercropping (growing 2 crops concurrently in one field) was widespread in the northern cereal-growing belt of the Eastern Gangetic Plains until the early 2000s, when disease restricted the area of wheat production. The recent and widespread production of maize – a wider row crop compared to wheat – creates new possibilities for intercropping. While wide-row intercropping has been investigated in North Asia and South America, little research has been conducted in South Asia. Potential benefits include increased cropping system productivity, increased water, labour and energy-use efficiencies, improved nutrition and food security for rural households, economic empowerment for women, and over the longer term, increased soil health. Ms Alison Laing of CSIRO is leading a small research activity on wide-row intercropping to test initial ideas and prepare a research project to design effective wide-row intercropping and determine its agronomic, social and economic implications in the Eastern-Gangetic Plains.[8]

Previous ACIAR projects have identified crop management options to increase productivity in the Eastern Gangetic Plains. This project led by Professor Fay Rola-Rubzen is identifying behavioural components of household decision-making about the adoption of new practices to support sustainable intensification based on conservation agriculture. In its final year, the project will collect evidence of the outcome of behavioural science-inspired methods to inform and engage farming families.[9]

Soil and Land Management

The translation of soil health information, particularly soil resilience, is generally of low value to smallholder farmers due to significant knowledge and language differences between those producing the information and their target audience. A new project led by Professor Chengrong Chen of Griffith University will take a transdisciplinary approach to develop soil health information. The project will bring researchers, farmers, extension agents and other stakeholders together to develop a shared understanding of soil-related problems and risks, particularly abiotic climate induced stress factors. The project will improve soil health and the resilience of farming systems in Bangladesh by developing co-designed solutions appropriate for smallholders.[10]

Improved nutrient management for emerging and more intensive cropping systems is the focus of a project in the coastal zone of Bangladesh, led by Murdoch University. Photo: Conor Ashleigh

Water

Improved nutrient management to increase the profitability and sustainability of intensive and emerging cropping systems is the focus of a project in the coastal zone of Bangladesh, led by Professor Richard Bell of Murdoch University. The first phase of the project (2017 to 2021) established that the adoption of fertiliser recommendation tools can decrease production costs and increase income and yield for smallholder farmers. The project has been extended until the end of 2022 to scale out the use of tools developed by the project and advance practice change. The final phase of the project will test a collective action approach for nutrient management and expand the scope for monitoring and evaluation of the innovations.[11]

The Ganges Delta region, in Bangladesh and India, is characterised by poverty, food insecurity, environmental vulnerability and limited livelihood opportunities, and is highly vulnerable to inundation from rising sea levels. Since 2016, ACIAR has partnered with the Krishi Gobeshona Foundation of Bangladesh to lift agricultural productivity, and hence rural welfare, by increasing cropping intensification. A new phase of the partnership, starting in 2022, aims to strengthen farmer confidence in the technologies introduced previously and demonstrate practices that may mitigate or avoid risks due to untimely rainfall and drainage management. Dr Mohammed Mainuddin of CSIRO leads the project that will also provide information to support the implementation of development plans in the region.[12]

The Eastern Gangetic Plains straddles Bangladesh, India and Nepal. The region is home to 450 million people and has the world's highest concentration of rural poverty. People in this region have a high dependence on agriculture for food and livelihood security. Dr Tamara Jackson of the University of Adelaide leads a project to understand the processes and practices of transforming food systems through diversification to improve farm livelihoods while reducing inequity, production risk and unsustainable resource use. By gaining an understanding of the existing context for diversification in the region, and associated technologies, scaling interventions, and policies and programs, the project will consider these elements individually and demonstrate the interactions between them using case studies to highlight where and how diversification has occurred in the past. In subsequent phases, the project will identify priority opportunities with communities and determine their fit with projected climate change and water availability, and the impact of high-level policies.[13]

Regional Manager, South Asia
Dr Pratibha Singh

Research Program Managers
Agribusiness: Mr Howard Hall
Climate Change: Dr Veronica Doerr
Crops: Dr Eric Huttner
Soil and Land Management: Dr James Quilty
Water: Dr Neil Lazarow

See page 186 for contact details.

Current and proposed projects

1. Understanding the drivers of successful and inclusive rural regional transformation: Sharing experiences and policy advice in Bangladesh, China, Indonesia and Pakistan (ADP/2017/024)
2. MAC-B: Mitigation adaptation co-benefits modelling trial in Bangladesh (CLIM/2021/109)
3. Locally led learning to turn polders into flexible assets for adaptation [Bangladesh] (CLIM/2021/137)
4. Incorporating salt-tolerant wheat and pulses into smallholder farming systems in southern Bangladesh (CIM/2014/076)
5. International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)
6. Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan (CROP/2020/167)
7. Managing wheat blast in Bangladesh: identification and introgression of wheat blast resistance for rapid varietal development and dissemination (CROP/2020/165)
8. Intercropping for intensification and diversification in the Eastern Gangetic Plains [Bangladesh, India] (CROP/2021/155)
9. Enhancing farm-household management decision-making for increased productivity in the Eastern Gangetic Plains [Bangladesh, India, Nepal] (CSE/2012/108)
10. Developing and translating soil health information in Bangladesh with farmers and for farmers to build resilient agricultural systems (SLAM/2021/107)
11. Nutrient management for diversified cropping in Bangladesh (LWR/2016/136)
12. Cropping system intensification in the salt-affected coastal zones of Bangladesh and West Bengal, India (LWR/2014/073)
13. Transforming smallholder food systems in the Eastern Gangetic Plain [Bangladesh, India, Nepal] (WAC/2020/148)

India

A$0.67 million
Budgeted funding

4
Bilateral and regional research projects

2
Small projects and activities

With more than 1.3 billion people, India is the second most populous country in the world, after China, and accounts for 18% of the world's population. Two-thirds of India's population live in rural areas, with landholdings averaging 1.1 hectares. The rural population is highly vulnerable to the impacts of a declining natural resource base, biosecurity threats and climate change.

Worth US$2.94 trillion, India is the world's fifth largest economy, overtaking the United Kingdom and France. India is emerging as a major agricultural exporter of several key commodities and is currently the largest exporter of rice globally and the second largest exporter of cotton. While the contribution of the agriculture sector to GDP is declining, agriculture remains a major source of employment and accounts for 42% of the total national workforce.

The COVID-19 pandemic and associated lockdowns affected all sectors of the Indian economy; however, agriculture emerged as the main driver of economic growth, recording positive growth of 3.4% (at constant prices) in 2020–21.

Agricultural production has been increasing by an average of 3.6% per year since 2011, due to improved access to inputs such as fertiliser and seed, irrigation and credit facilities. The sector has also diversified from cereal grains to pulses, fruit, vegetables and livestock products, largely driven by evolving demographics, urbanisation and changing consumer demand patterns. However, the sector is still challenged by inefficient market mechanisms, subsidy distortions, lack of storage infrastructure, inefficient use of natural resources and susceptibility to climate change and extreme weather events.

In response to the COVID-19 pandemic, the government announced the 'Atmanirbhar Bharat Abhiyan' (Self-Reliant India) program in 2020. The initiative included institutional credit facilities at concessional rates, creation of an Agriculture Infrastructure Development Fund for projects at farm-gate and aggregation points, and release of emergency funds to provide working capital to farmers through crop loans. The initiative continued into 2021 with increased allocation to the infrastructure fund.

The Government of India, in its various policies and schemes, focuses closely on the role of women in agriculture. It advocates mainstreaming of women's role in agriculture as part of all programs in the agricultural development agenda.

Although 30% of budgetary allocations under various schemes have been made for women farmers, fund utilisation under these schemes has declined. Moreover, due to the complex and varied nature of agriculture in India, there has been a trend of defeminisation in certain pockets of the country. Although policy articulation by the government on the rights of women farmers has shifted, there is still a huge knowledge gap and limited resources to implement gender-inclusive agricultural development strategies.

In June 2020, the leaders of both countries participated in the Australia–India Leaders' Virtual Summit, where they elevated the bilateral Strategic Partnership to a Comprehensive Strategic Partnership. One initiative agreed under the partnership is that India and Australia will boost collaboration on science, technology and research, initially focused on COVID-19 responses. As part of the response being coordinated by Australia's High Commission, in 2022–23 ACIAR is working to clarify the role we can play in supporting the ambition for increased research collaboration between India and Australia.

In April 2022, the Australia–India Economic Cooperation and Trade Agreement was signed. The agreement includes a provision that both countries will cooperate to promote agricultural trade as part of the agreement and will work toward concluding an enhanced agricultural Memorandum of Understanding (MoU). An update to An India Economic Strategy 2035, an ambitious plan to transform Australia's economic partnership with India out to 2035, was also launched in April 2022. The Strategy was an independent report submitted to the Australian Government in 2018.

Country priorities

ACIAR has supported a program of collaborative research with India since 1983. Presently, the ACIAR research program with India is delivered entirely through a regional collaborative approach involving neighbouring countries with shared issues and opportunities. Substantial co-investment from India will increasingly become a desired characteristic of our partnership to maintain an ongoing program of collaboration in future.

The geographic focus on the eastern regions of India and its neighbours will remain the same, with a thematic focus on:

- management of agricultural water, including rainfed areas in the Eastern Gangetic Plains and coastal zone
- sustainable intensification and diversification of cropping systems with support of conservation agriculture/zero tillage
- breeding of improved varieties of mungbean
- assisted policy development for farmers' livelihoods and climate change.

Existing collaboration between ACIAR and organisations in India has the potential to evolve into a substantial co-invested partnership providing benefits for both countries. As a result of a recent partnership refresh between ACIAR and Indian Council of Agricultural Research, in 2022–23 we will explore, at India's request, the possibilities for enhanced collaboration in:

- sustainable intensification with a nutrition framework
- diversification into new dry-season crops
- the role of biotechnology in crop development
- new mechanisation opportunities including farm robotics
- a next phase of mungbean breeding for high-yielding varieties
- groundwater management (overexploitation and under-exploitation)
- co-investment and trilateral collaboration.

2022–23 research program

- **6 ACIAR-supported projects in India**
- **1 project is specific to this country**
- **5 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in India. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Crops

Mungbean is an ideal rotation crop for smallholder farmers throughout the Indian Ocean Rim region. The International Mungbean Improvement Network, established through a project led by Dr Ramakrishnan Nair of the World Vegetable Center, helped realise the potential of mungbean to improve cropping system productivity and livelihoods by improving researchers' access to genetic material, and coordinating and providing technical support to variety development in Bangladesh, India, Myanmar and Australia. Phase 2 of the project extends the network to Kenya and Indonesia, expanding the source of germplasm to develop new mungbean varieties, as well as strengthening the capacity of more national mungbean breeding programs.[1]

The practice of intercropping (growing 2 crops concurrently in one field) was widespread in the northern cereal-growing belt of the Eastern Gangetic Plains until the early 2000s, when disease restricted the area of wheat production. The recent and widespread production of maize – a wider row crop compared to wheat – creates new possibilities for intercropping. While wide-row intercropping has been investigated in North Asia and South America, little research has been conducted in South Asia. Potential benefits include increased cropping system productivity, increased water, labour and energy-use efficiencies, improved nutrition and food security for rural households, economic empowerment for women, and over the longer term, increased soil health. Ms Alison Laing of CSIRO is leading a small research activity on wide-row intercropping to test initial ideas and prepare a research project to design effective wide-row intercropping and determine its agronomic, social and economic implications in the Eastern-Gangetic Plains.[2]

Previous ACIAR projects have identified crop management options to increase productivity in the Eastern Gangetic Plains. This project led by Professor Fay Rola-Rubzen is identifying behavioural components of household decision-making about the adoption of new practices to support sustainable intensification based on conservation agriculture. In its final year, the project will collect evidence of the outcome of behavioural science-inspired methods to inform and engage farming families.[3]

Water

The Ganges Delta region, in Bangladesh and India, is characterised by poverty, food insecurity, environmental vulnerability and limited livelihood opportunities, and is highly vulnerable to inundation from rising sea levels. Since 2016, ACIAR has partnered with the Krishi Gobeshona Foundation of Bangladesh to lift agricultural productivity, and hence rural welfare, by increasing cropping intensification. A new phase of the partnership, starting in 2022, aims to strengthen farmer confidence in the technologies introduced previously and demonstrate practices that may mitigate or avoid risks due to untimely rainfall and drainage management. Dr Mohammed Mainuddin of CSIRO leads the project that will also provide information to support the implementation of development plans in the region.[4]

The Eastern Gangetic Plains straddles Bangladesh, India and Nepal. The region is home to 450 million people and has the world's highest concentration of rural poverty. People in this region have a high dependence on agriculture for food and livelihood security. Dr Tamara Jackson of the University of Adelaide leads a project to understand the processes and practices of transforming food systems through diversification to improve farm livelihoods while reducing inequity, production risk and unsustainable resource use. By gaining an understanding of the existing context for diversification in the region, and associated technologies, scaling interventions, and policies and programs, the project will consider these elements individually and demonstrate the interactions between them using case studies to highlight where and how diversification has occurred in the past. In subsequent phases, the project will identify priority opportunities with communities and determine their fit with projected climate change and water availability, and the impact of high-level policies.[5]

Australian experts are providing technical support to 5 large land and water management programs in the Indian states of Andhra Pradesh and Odisha. These programs draw on previous ACIAR-supported projects on climate risk management, participatory groundwater management and social learning for irrigation management and governance. Dr Uday Nidumolu of CSIRO Agriculture and Food leads the project, which will work with Indian counterparts to integrate the research, support out-scaling and then co-learn about out-scaling. COVID-19 outbreaks in South Asia mean that training will be delivered online and field activities have been postponed.[6]

Regional Manager, South Asia
Dr Pratibha Singh

Research Program Managers
Crops: Dr Eric Huttner
Water: Dr Neil Lazarow

See page 186 for contact details.

Current and proposed projects

1. International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)
2. Intercropping for intensification and diversification in the Eastern Gangetic Plains [Bangladesh, India] (CROP/2021/155)
3. Enhancing farm-household management decision-making for increased productivity in the Eastern Gangetic Plains [Bangladesh, India, Nepal] (CSE/2012/108)
4. Cropping system intensification in the salt-affected coastal zones of Bangladesh and West Bengal, India (LWR/2014/073)
5. Transforming smallholder food systems in the Eastern Gangetic Plain [Bangladesh, India, Nepal] (WAC/2020/148)
6. Water management for smallholder farmers: Outscaling ACIAR research in Andhra Pradesh Drought Mitigation Program [India] (WAC/2018/164)

Nepal

A$0.77 million
Budgeted funding

3
Bilateral and regional research projects

Agriculture is the largest economic sector of Nepal. It supports livelihoods of 66% of the population and contributes 36% of national GDP. Farming is largely subsistence and cropping is mostly integrated with livestock production.

Agriculture in Nepal is highly diverse due to the wide range of climates and geographies in the country. The challenges facing agriculture in the lowland Terai rice–wheat farming systems (part of the Eastern Gangetic Plains) are vastly different to those in the mixed crop–livestock–tree farming systems of the hill and mountain areas. Broadly, however, the challenges include:

- the need for seed system improvements
- degradation of natural resources
- underdeveloped agricultural institutions and policies
- declining availability of labour
- access to productive technologies and mechanisation to improve farm household livelihoods.

Natural disasters frame the recent history of the country. In 2015, the deadliest earthquake in 81 years struck Nepal, followed by hundreds of aftershocks and another severe earthquake 17 days later. The process of recovery continues. In 2017, Nepal was hit by devastating floods, causing US$172 million in losses and damage to the agriculture sector alone.

Nepal's Agriculture Development Strategy 2015–2035 outlines a vision for a self-reliant, sustainable, competitive and inclusive agriculture sector that drives economic growth and contributes to improved livelihoods and food and nutrition security. It conceptualises transformation of Nepal from a society primarily based on agriculture to one that derives most of its income from services and industry. The 20-year strategy aims to halve poverty in less than 10 years through an agriculture-led economy achieving improved governance, higher productivity, profitable commercialisation and increased competitiveness.

The Agriculture Development Strategy also guides policies that include women, and states that all agricultural programs will be designed to benefit women. It promotes women's organisations and agroenterprises led by women through specific programs and recommends equal wages for women labourers. The strategy also promotes action to raise awareness of women's rights to land, and builds the capacity of women to manage irrigation, water resources and finances.

Country priorities

ACIAR has supported collaborative research with Nepal since the early 1990s, including projects on small ruminants, wheat and legumes. The focus for ACIAR during 2022–23 continues to be the engagement of Nepal in a regional program to improve integration of soil, water, crop, livestock and tree components of the farming systems.

Increased farm and forest productivity remains a core priority of Nepal for collaboration with ACIAR to improve food and nutrition security of the rural poor. In the Middle Hills districts, where the impacts of earthquakes and floods remain, our program supports the request of the Nepalese Government to focus primarily on research to support increased timber production from community forests. Another area of requested focus is understanding the implications of federalism on agriculture in Nepal.

Given the common agricultural production challenges across the alluvial plains of Nepal, eastern India and Bangladesh, cooperative research linkages with neighbouring countries will be explored further during 2022–23. The focus will be on conservation agriculture, to address key issues such as declining soil health, burning of rice stubble, falling groundwater levels and inequities in access to water.

Nepal hosts an important regional research body – the International Center for Integrated Mountain Development. ACIAR and DFAT are working with the center to identify prospective areas for research collaboration.

2022–23 research program

- **3 ACIAR-supported projects in Nepal**
- **1 project is specific to this country**
- **2 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Nepal. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Crops

Previous ACIAR projects have identified crop management options to increase productivity in the Eastern Gangetic Plains. This project led by Professor Fay Rola-Rubzen is identifying behavioural components of household decision-making about the adoption of new practices to support sustainable intensification based on conservation agriculture. In its final year, the project will collect evidence of the outcome of behavioural science-inspired methods to inform and engage farming families.[1]

Forestry

The Middle Hills of Nepal are home to 44% of the country's population, and most people gain their livelihoods from a combination of agricultural and forest products. Most forest lands have been returned to community forest user groups, with suboptimal management and minimal timber harvest. Previous ACIAR-supported work demonstrated the effectiveness of a silvicultural management package called Active and Equitable Forest Management to improve livelihoods, social equity and environmental impacts. Dr Ian Nuberg of the University of Adelaide leads a project focusing on adopting improved forestry practices, developing community forestry planning, governance and gender equity frameworks, and poverty-reducing, small-scale forest enterprises in Kahbre Palanchok and Sindhu Palchok districts. In 2022–23, researchers will document case studies and report on the policy implications of research on community forest enterprises.[2]

Water

The Eastern Gangetic Plains straddles Bangladesh, India and Nepal. The region is home to 450 million people and has the world's highest concentration of rural poverty. People in this region have a high dependence on agriculture for food and livelihood security. Dr Tamara Jackson of the University of Adelaide leads a project to understand the processes and practices of transforming of food systems through diversification to improve farm livelihoods while reducing inequity, production risk and unsustainable resource use. By gaining an understanding of the existing context for diversification in the region, and associated technologies, scaling interventions, and policies and programs, the project will consider these elements individually and demonstrate the interactions between them using case studies to highlight where and how diversification has occurred in the past. In subsequent phases, the project will identify priority opportunities with communities and determine their fit with projected climate change and water availability, and the impact of high-level policies.[3]

Regional Manager, South Asia
Dr Pratibha Singh

Research Program Managers
Crops: Dr Eric Huttner
Forestry: Dr Nora Devoe
Water: Dr Neil Lazarow

See page 186 for contact details.

Current and proposed projects

1. Enhancing farm-household management decision-making for increased productivity in the Eastern Gangetic Plains [Bangladesh, India, Nepal] (CSE/2012/108)
2. Enhancing livelihoods through improved forest management in Nepal (FST/2017/037)
3. Transforming smallholder food systems in the Eastern Gangetic Plain [Bangladesh, India, Nepal] (WAC/2020/148)

Pakistan

A$3.59 million
Budgeted funding

9
Bilateral and regional research projects

4
Small projects and activities

Agriculture is the largest sector of Pakistan's economy, contributing 19% to GDP and engaging 38% of the national workforce. This is the largest segment of the workforce and two-thirds are women. Pakistan's strong research system has been driving innovation and improvements in this sector.

The COVID-19 pandemic has put significant pressure on the economy of Pakistan. Drastic measures to control the pandemic significantly reduced economic activity (including activity in agrifood systems), with consequent impacts on livelihoods, food security and nutrition.

Before the pandemic, about 25% of the population lived below the national poverty line. Food insecurity is typically high, with 20–30% of the population (40 to 62 million people) experiencing some form of food insecurity and chronic vulnerability through natural hazards and shocks, including the ongoing pandemic. The continued lockdown has affected the demand for food. This is due not only to limited physical access but also declining financial resources. Lockdown reduced or eliminated the earnings of almost 3 million informal daily wage labourers working in agriculture and other related activities.

Food market mechanisms in Pakistan are strong and well-integrated but temporary supply shocks occurred due to disturbance in logistics. This affected the price and supply of perishable goods, imported food and processed food. Along with a high rate of population growth, food and water security are among the most pressing challenges for Pakistan in the current circumstances.

Pakistan recognises that cost-effective availability of energy, water and food is essential to ensure sustainable economic growth and development. Sizeable national and provincial programs are being funded to revolutionise the agriculture and livestock sectors. These programs are aimed at increasing agricultural productivity and value addition, reducing dependence on imports, supporting and stimulating agriculture-based industries, and improving the livelihoods and wellbeing of farming communities.

Pakistan is ranked third in the world of countries facing water shortages. It is estimated that Pakistan will become the most water-stressed country in South Asia by 2040, with absolute water scarcity by 2025. There are many reasons for the country's water scarcity. The most important are climate change, urbanisation and high dependence on groundwater for agriculture and other operations.

Country priorities

Australia has a 70-year development assistance relationship with Pakistan, which has contributed to Pakistan's long-term economic prosperity, stability and resilience. ACIAR is regarded as a key international partner supporting agricultural research in Pakistan. Australia is seen as a country with deep, relevant expertise in agriculture, livestock production and water management. Our work is high profile and regularly gains the attention of policymakers at national and provincial levels.

Australia has helped Pakistan increase livelihood opportunities for men and women living in poverty by enhancing agricultural productivity and expanding revenue streams for farmers through improved water management practices, adding value to raw agricultural products and improving access to markets. Our programs have invested in the people of Pakistan, especially women and girls.

Our program with Pakistan is based on Australia's global expertise in areas that are high-priority concerns for Pakistan, and the recognition that water and food security are critical to Pakistan's long-term stability. Pakistan's strong network of researchers has a longstanding platform of collaboration with Australian researchers, which is highly valued by both countries.

The ongoing focus of our research collaboration is:

- empowering women to enhance farm incomes
- water management, particularly horizontal expansion, salinity management, water harvesting, and low-cost/high-efficiency irrigation systems
- crop improvement, particularly productivity enhancement and access to novel breeding techniques
- horticulture, including fresh produce and nursery certification systems
- agribusiness development, including background research in value-adding, product development, branding and traceability systems for growing private sector needs, which the national system cannot provide
- models for rural transformation.

When pandemic conditions permit, we will recalibrate our relationship with Pakistan with a 10-year plan for research cooperation. This will enable a stronger equal partnership of international research collaboration with substantial co-investment for mutual benefit.

2022–23 research program

- **13 ACIAR-supported projects in Pakistan**
- **10 projects are specific to this country**
- **3 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations.

The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in Pakistan. The projects are grouped according to research program. Each project description is referenced in a list at the end of this section, which provides the project title and code.

The Quaid-i-Azam University leads a new project using mango and tomato as focal commodities to map value chains in Pakistan and Sri Lanka, to identify the extent and root causes of food losses.

Agribusiness

Success in rural transformation is measured not only by income growth in the rural population, but also by the degree of inclusiveness in the society. A project in China, Bangladesh, Indonesia and Pakistan, led by Dr Chunlai Chen of the Australian National University, endeavours to understand the nature and drivers of rural transformation in order to provide better policy advice to underpin the success of transformation. During 2022–23, researchers will analyse and report on the results of their study into the components of success and the different impacts of rural transformation on women and men.[1]

Pulses are important to both agricultural systems and diets in Pakistan, but domestic production has declined in recent decades. Pakistan now imports 80% of lentils and 10% of chickpeas to meet domestic demand. A project led by Dr Rajendra Adhikari of the University of Queensland is developing socially inclusive and competitive value chains for pulses in Punjab and Sindh, with spillover benefits expected for Khyber Pakhtunkhwa. These 3 regions are characterised by gender inequality within industry and society. Chickpeas, lentils and mungbean are well-suited to smallholder farming by both women and men. Before the project concludes in 2023, researchers will deliver capacity building activities for smallholder farmers to improve connections between farmers and markets and finalise policy advice and recommendations for decision-makers to assist industry development.[2]

Fresh fruits and vegetables are important food commodities in both Pakistan and Sri Lanka. Maintaining quality and freshness under humid tropical conditions presents a vast challenge in meeting the growing demand for domestic consumption and export. Supply chains are inadequate and inefficient. Food losses are large, especially during seasonal gluts. Associate Professor Anwar Shah of Quaid-i-Azam University leads a new project using mango and tomato as focal commodities to map value chains in Pakistan and Sri Lanka, to identify the extent and root causes of food losses. The project will design and demonstrate affordable technological and organisational options to mitigate losses and create new economic opportunities. Sri Lanka provides a useful case study to contrast its fruit and vegtable value chain against Pakistan. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).[3]

Crops

Hybrid wheat has the potential to produce more grain from the same or less land, significantly contributing to food security and land sustainability. However, technical difficulties of hybrid wheat development and the high cost of hybrid seed have constrained the commercial development of new varieties for many decades. Professor Richard Trethowan of the University of Sydney leads a project that aims to extend the benefits of new hybrid wheat systems to researchers, wheat breeders, farmers and consumers in Pakistan, Bangladesh and Ethiopia. The university has developed a novel, cost-effective and practical system to rapidly produce large numbers of wheat hybrid combinations for testing in breeding programs, and to produce large amounts of hybrid seed for sale to farmers at an acceptable cost. The project will establish the performance of the hybrids, and determine effective technical processes and business models to produce the seed in collaboration with the national programs and local seed providers in each country.[4]

The demand for pulses in Pakistan has been increasing, while production is decreasing. Despite relatively high prices, pulses, especially chickpea and lentils, have been pushed out to the most marginal lands, and labour shortages are a major production constraint. Reintroducing legumes into existing cropping systems would have nutritional, economic and environmental benefits and has been identified as a priority for agriculture development by the Pakistan Government. In its final year, the 6-year project led by Dr Ata-ur Rehman of Charles Sturt University will use results to engage partners and farmers in scaling out effective innovations to intensify pulses production and increase productivity. The project will also identify emerging knowledge gaps and research opportunities to improve pulses production in Pakistan.[5]

Horticulture

The horticulture sector in Pakistan is significant, both domestically and for export production. Dr Babar Ehsan Bajwa of CABI leads a project to strengthen selected vegetable value chains in Punjab and Sindh provinces as part of the Agriculture Value Chain Collaborative Research Program (Aik-Saath). Focusing on potatoes, chillies, tomatoes and onions, in 2022–23, the project team will deliver capacity building activities to support the implementation, scaling out and monitoring of interventions and improve pre and post-harvest processes, from improved seedlings and variety selection to better packaging, transport, and marketing.[6]

Citrus is Pakistan's leading fruit crop, and although production is increasing, productivity is below comparable countries, farm-gate waste is high and value is stagnant. Waste continues throughout the value chain, with post-harvest losses in citrus ranging between 23% and 38%. Despite these limitations, the industry's main product, Kinnow mandarin, has market potential at higher levels of quality and value, especially for export. Further, citrus industry development is a priority for provincial and national governments. A project led by Dr Rajendra Adhikari of the University of Queensland aims to improve the wellbeing of citrus-producing smallholder families through participation in inclusive value chains that meet market needs and provide equitable returns to farmers.[7]

Water

Salinity currently affects 4.5 million hectares of land across Pakistan and 54% of the southern Indus Basin, threatening agricultural production and livelihoods, resulting in high rates of poverty for communities living in affected areas. A project led by Dr Michael Mitchell of Charles Sturt University aims to build the adaptive capacity of farming and coastal communities in salinity-affected areas to maintain and improve their livelihoods. During 2022–23, the project will finalise analysis and report on the status and future trends of salinity in southern Indus Basin, including policy and management recommendations, and capacity building and mentoring of next users of groundwater monitoring and modelling tools. The project will report on for future research into adaptation strategies, drawing on value chain analysis; and prepare a strategy for scaling out selected adaption strategies beyond the life of the project.[8]

In Pakistan, inland groundwater reserves over a large area of the country are saline, and about 40,000 hectares of agricultural land are abandoned within the Indus Basin annually due to secondary salinisation. Aquaculture is an enterprise option for saline areas that are not suitable for crop cultivation. Scientists from the International Water Management Institute and the WorldFish Centre, led by Dr Mohsin Hafeez, reviewed the options and potential for brackish and marine aquaculture in Pakistan, and the extent to which aquaculture could provide a transformative adaptation strategy for areas affected by salinisation in the southern Indus Basin. The project concludes in 2022 with the development of practical and simple guidelines to assist farmers and local extension agents implement viable options for brackish aquaculture, for sustainable livelihoods in saline areas.[9]

Irrigated cropping is critical to Pakistan's economy and food security, and effective management of the country's irrigation is an urgent priority. While basin-level water management is efficient, distribution of water at the community level is inefficient and unfair, and yields and water productivity are low. A small project is being led by Mr Simon Dyer, Managing Director of Virtual Irrigation Academy, a company created to scale out water monitoring technology developed by CSIRO. The project aims to create viable and sustainable business models in Pakistan to supply farmers with water monitoring tools developed by the Virtual Irrigation Academy program, which provides a digital platform to monitor soil water, underpinned by a process of social learning to improve irrigation management at the farm and scheme level. The program was developed through ACIAR-supported projects in southern Africa.[10]

Irrigated cropping is critical to Pakistan's economy and food security, and effective management of the country's irrigation is an urgent priority, and a focus of several ACIAR-supported projects.

The Indus Basin Irrigation System is the world's largest continuous irrigation system and it provides water, energy and food security for Pakistan. Responsibility for the system's surface water resources is shared between the Indus River System Authority, the Water and Power Development Authority and provincial irrigation departments. Allocation of the water resource is a complex process that is only a few people understand. CSIRO, through a DFAT-funded project in close collaboration with partners in Pakistan, developed the Water Apportionment Accord Tool to enable a more transparent and consistent allocation process. Dr Mobin-ud Din Ahmad of CSIRO leads a small project that is supporting and training in-country partners to use the tool for 2 rounds of seasonal planning (Kharif and Rabi). The experience will be used to further develop and refine the software and a user guide.[11]

Groundwater is essential for more than 50% of irrigation requirements in Punjab and up to 20% in Sindh, but the resource is poorly understood and its use largely unregulated. Government and water users recognise the need to improve groundwater management but institutional frameworks for regulation and management are largely lacking. A two-level approach to groundwater management is needed: strategic planning and coordination of actions, and site-specific research and operational management. Dr Jay F Punthakey and Dr Catherine Allan of Charles Sturt University lead a new project to support knowledge creation, sharing and co-design for improved systems of sustainable groundwater management in selected farming communities in Punjab and Sindh. It is expected that this work will contribute to the development of national and provincial frameworks to sustain the long-term productive potential of groundwater and better integrate groundwater into water resource management plans. The project consolidates and builds on past and current ACIAR research investment in improving groundwater management in Pakistan.[12]

The combination of saline landscapes and low forest cover presents numerous and compounding challenges for smallholder farmers in Sindh, Pakistan. With strong linkages to existing ACIAR-supported projects, this small research activity will evaluate the potential of tree planting to manage salinity and increase income in smallholder farming systems. The project will synthesise existing knowledge of suitable species, their characteristics, uses and appropriate management; and well as identify and develop effective forestry extension methods and materials to deliver the knowledge to extension workers and educated smallholders. Concurrently, the project will engage with smallholders and extension workers to ground truth a synthesis of current literature and provide further insights into the knowledge, practices, needs and pressures of smallholders in several different landscapes.[13]

Country Manager, Pakistan
Dr Munawar Raza Kazmi

Research Program Managers
Agribusiness: Mr Howard Hall
Crops: Dr Eric Huttner
Horticulture: Ms Irene Kernot
Water: Dr Neil Lazarow

See page 186 for contact details.

Current and proposed projects

1. Understanding the drivers of successful and inclusive rural regional transformation: Sharing experiences and policy advice in Bangladesh, China, Indonesia and Pakistan (ADP/2017/024)
2. Developing competitive and inclusive value chains of pulses in Pakistan (ADP/2017/004)
3. Developing food loss reduction pathways through smart business practices in mango and tomato value chains in Pakistan and Sri Lanka (Food Loss Research Program) (CS/2020/193)
4. Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan (CROP/2020/167)
5. Increasing productivity and profitability of pulse production in cereal-based cropping systems in Pakistan (CIM/2015/041)
6. Strengthening vegetable value chains in Pakistan for greater community livelihood benefits (HORT/2016/012)
7. Improving smallholder wellbeing through participation in modern value chains: sustaining future growth in the Pakistan citrus industry (HORT/2020/129)
8. Adapting to salinity in the southern Indus Basin [Pakistan] (LWR/2017/027)
9. Opportunities for brackish and saline aquaculture in Pakistan (WAC/2020/179)
10. Virtual Irrigation Academy business models in Pakistan (WAC/2020/180)
11. Supporting inter-provincial water allocation decision making in Pakistan (WAC/2021/103)
12. Groundwater management in Pakistan (WAC/2021/134)
13. Trees for salinity management, Sindh, Pakistan (WAC/2021/136)

Sri Lanka

A$0.61 million
Budgeted funding

2
Bilateral and regional research projects

After a 26-year civil war and a tsunami in 2004 that left tens of thousands of people dead, injured or homeless, Sri Lanka moved ahead rapidly to achieve middle-income country status.

Following the early optimism about prospects for the country after peace was established, in mid-2022 Sri Lanka is facing its worst ever economic crisis, with food and fuel price spikes driving civil unrest. Australia continues to have a strong interest in ensuring Sri Lanka can be a secure, stable and prosperous partner of Australia in the Indian Ocean region.

ACIAR had a broad collaborative research program with Sri Lanka from 1980 to the early 2000s, which covered fisheries, agriculture policy, forestry, animal health and crops. In 2016, Australia's Commission for International Agricultural Research requested an assessment of re-establishing a collaborative research program with Sri Lanka. A scoping study[3] identified 6 broad areas for potential future collaboration with Sri Lanka. Given that the partnership was new, we decided to start small with a single project. ACIAR was looking to this project to identify lessons for possible further re-engagement based on significant co-investment from Sri Lanka. The current economic and political crisis puts any possibility of re-engagement on hold.

3 de Meyer, J., Curnow, J., 2016. ACIAR Scoping study: Re-engagement in agricultural research for development partnerships in Sri Lanka. Australian Centre for International Agricultural Research: Canberra. 52 pp.

2022–23 research program

Agribusiness

Fresh fruits and vegetables are important food commodities in both Pakistan and Sri Lanka. Maintaining quality and freshness under humid tropical conditions presents a vast challenge in meeting the growing demand for domestic consumption and export. Supply chains are inadequate and inefficient. Food losses are large, especially during seasonal gluts. Associate Professor Anwar Shah of Quaid-i-Azam University leads a new project using mango and tomato as focal commodities to map value chains in Pakistan and Sri Lanka, to identify the extent and root causes of food losses. The project will design and demonstrate affordable technological and organisational options to mitigate losses and create new economic opportunities. Sri Lanka provides a useful case study to contrast its fruit and vegetable value chain against Pakistan, as the 2 countries are at different stages of development and face different exposure regimes and vulnerabilities. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).

Project: Developing food loss reduction pathways through smart business practices in mango and tomato value chains in Pakistan and Sri Lanka (Food Loss Research Program) (CS/2020/193)

Fisheries

Sri Lanka has a well-developed and sustainable inland reservoir fishery that makes up about 12–15% of total fish production and significantly benefits rural communities in the former conflict-affected Northern province. Based on a co-management strategy, management practices and stocking strategies for sustainable culture-based fisheries have been established in a previous ACIAR project and have increased the productivity of the reservoir fishery. The Government of Sri Lanka has long recognised the potential for the extensive culture of the indigenous giant freshwater prawn (Macrobrachium rosenbergii) in inland reservoirs, but development has been ad hoc, with productivity and returns relatively low. A project led by Dr Clive Jones of James Cook University investigates stocking, monitoring and harvesting practices to optimise fish and prawn productivity and improve product quality. The project will also conduct market-chain analysis to ensure farming practices meet market product requirements and benefits are socially equitable.

Project: Improved productivity, efficiency and sustainability of the culture-based fishery for finfish and giant freshwater prawn in Sri Lankan reservoirs (FIS/2018/157)

Regional Manager, South Asia
Dr Pratibha Singh

Research Program Manager
Agribusiness: Mr Howard Hall
Fisheries: Prof Ann Fleming

See page 186 for contact details.

Maintaining quality and freshness under humid conditions presents a vast challenge in meeting standards for domestic and export markets. Food losses are large, especially during seasonal gluts. A new project, focusing on mango and tomato, will map value chains in Pakistan and Sri Lanka, to identify the extent and root causes of food losses.

5.4

Eastern and Southern Africa

Photo: Emmie Wachira

Eastern and Southern Africa

Economic performance of the African region has been strong for several years, but the COVID-19 pandemic has taken a heavy toll on lives and economies. Despite the impact of the pandemic, the region continues to recover from its worst recession in more than half a century and with economic growth of 3.4% in 2022.

Eastern and southern African countries have been the most affected by the economic impacts of the pandemic, with heavy disruptions to tourism-dependent, oil-exporting and other-resource intensive economies, resulting in deepening inequality. An estimated 39 million Africans could slip into extreme poverty this year, following about 30 million who were pushed into extreme poverty in 2020 as a result of the pandemic. However, economic recovery is fuelled by elevated commodity prices, the relaxation of stringent pandemic measures, and recovery in global trade. The region remains vulnerable due to low rates of vaccination on the continent, protracted economic damage, and the slow pace of recovery.

Despite its incredible diversity at a macro level, Africa has a greater proportion of poor people on average than any other region in the world, and the region is characterised by high levels of food insecurity and very low Human Development Index rankings. If the current trend continues, Africa will need to intensify its efforts to meet the United Nations' Sustainable Development Goals, including Goal 1 of eradicating extreme poverty by 2030.

Africa's urban population has been growing at a very high rate and is projected to reach 56% of the total population (currently 44% of 1.34 billion) by 2050. Africa's demand for food is expected to more than double by that time, driven by population growth, rising incomes, rapid urbanisation, changes in national diets towards greater consumption of higher-value fresh and processed foods, and more open intra-regional trade policies. This is compounded by impacts associated with climate change, which continue to hamper agricultural production, productivity and reliability and increase the demand for land and water. In addition, rural demographics continue to change. Rural populations are ageing, many farms are getting smaller, and rural youth are looking for more lucrative livelihoods in urban areas rather than in traditional farming.

These changes are helping create new opportunities for Africa's smallholder farmers. Their small farms are transforming into business operations, which in turn brings new challenges to the agricultural systems.

Agriculture typically accounts for 30–40% of the GDP of African countries and more than 70% of the continent's poor live in rural areas. While agriculture remains a key driver of the economic growth required to deliver economic transformation for the rural poor, growth in productivity and production have broadly stagnated in the past decade. Unlocking the potential of Africa's agricultural and food systems requires substantial investment in the agriculture sector and in research to provide the knowledge that underpins growth in agricultural productivity, especially for commercialising smallholder farming.

Partner countries in the ACIAR Eastern and Southern Africa region

- Burundi
- Ethiopia
- Kenya
- Malawi
- Mozambique
- Nigeria
- Rwanda
- South Africa
- Tanzania
- Uganda
- Zambia
- Zimbabwe

Drivers of regional collaboration

The Comprehensive Africa Agriculture Development Programme (CAADP) of the African Union, in collaboration with the Regional Economic Communities, has been at the helm of mobilising the interest and commitment of African member states and their stakeholders for the transformation of the African agriculture sector.

A major milestone was the adoption of the 2014 Malabo Declaration on Accelerated African Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, in which the heads of states agreed to spend a minimum of 10% of their total expenditure on agriculture and pursue a target of 6% annual growth. Subsequently, the leaders noted the need for monitoring, tracking and reporting on the implementation of the declaration using the CAADP Results Framework.

In response to this, the African Union introduced a biannual review, the Africa Agriculture Transformation Scorecard, which tracks and reports each country's progress towards achieving the goals and targets of the Malabo Declaration. This important mechanism ensures that there is political will, backed by appropriate actions, to achieve agricultural growth and transformation in Africa.

The scorecard is presented at the African Green Revolution Forum, a key annual pan-African forum with a goal of accelerating progress on agriculture's contribution to economic growth and transformation, in line with delivering on the Malabo commitments.

The forum has become a premier platform for leaders from across Africa and around the world to advance concrete action plans and share knowledge to tap the enormous potential of agriculture in driving equitable and sustainable economic growth across the continent. The Alliance for a Green Revolution in Africa, in collaboration with several investors, coordinates the forum and produces a report on the forum, the Africa Agriculture Status Report.

Regional collaboration is crucial to achieving economic development in Africa, and the role of regional and sub-regional organisations is key, including the promotion and protection of foreign investment.

We are closely linked in with the main regional agencies including the Forum for Agricultural Research in Africa and the African Union Development Agency–New partnership for Africa Development and the Forum for Agricultural Research in Africa which remain important knowledge brokers and sources of priorities for the region.

We also liaise with sub-regional organisations, which are important strategic partners and play a key role in enhancing our impact to a regional scale, especially the Association for Strengthening Agricultural Research in Eastern and Central Africa and the Food, Agriculture, and Natural Resources Policy Analysis Network.

A good source for calibrating our regional priorities comes from the annual African Green Revolution Forum, which aims to advance concrete action plans and share knowledge to tap into the enormous potential of agriculture in driving equitable and sustainable economic growth across the continent.

TISA project assistant Emmanuel Kimaro (right) talks with farmer Zamda Tave, of Kiwere. Mr Kimaro works on a project that has introduced soil and water management technologies to farmers in 3 countries, to increase productivity and incomes, and make irrigation schemes more self-sustaining. Photo: Andrew Munuwa

Eastern and Southern Africa region program 2022–23

Partner country	No. projects
Burundi	1
Ethiopia	6
Kenya	9
Malawi	4
Mozambique	5
Nigeria	1
Rwanda	2
South Africa	4
Tanzania	5
Uganda	5
Zambia	2
Zimbabwe	5

Note that a project may be conducted in several countries, therefore the total number of projects in this table will be greater than the number of projects in the region.

This data was compiled in August 2022. Additional projects may be commissioned during 2022–23.

Research portfolio

3 Agribusiness projects

1 Climate Change project

9 Crops projects

0 Fisheries projects

2 Forestry projects

1 Horticulture project

7 Livestock Systems projects

0 Social Systems projects

0 Soil and Land Management projects

3 Water projects

5 CultiAF2 projects

Table 5.4 Current and proposed projects in the Eastern and Southern Africa region, 2022–23

Project title	Project code	Country
Agribusiness		
Kwale agricultural research for development project, Kenya	AGB/2021/123	Kenya
Managing food value chains for improved nutrition for urban vulnerable populations in Lusaka City (Zambia) (AfricitiesFood)	CS/2020/210	Zambia
Managing food value chains for improved nutrition for urban vulnerable populations in Mzuzu City (Malawi) (AfricitiesFood)	CS/2021/115	Malawi
Climate Change		
Supporting the tracking sharing learning platform of the Adaptation Research Alliance	CLIM/2022/108	Global
Crops		
Faba bean in Ethiopia: Mitigating disease constraints to improve productivity and sustainability	CIM/2017/030	Ethiopia
Rapid breeding for reduced cooking time and enhanced nutritional quality in common bean (*Phaseolus vulgaris*)	CROP/2018/132	Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda
International Mungbean Improvement Network 2	CROP/2019/144	Bangladesh, India, Indonesia, Kenya, Myanmar
Protecting Ethiopian lentil crops	CROP/2020/164	Ethiopia
Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan	CROP/2020/167	Bangladesh, Ethiopia, Pakistan
Australian technology reaches the field: Supporting and monitoring the release of pod-borer resistant cowpea	CROP/2021/165	Nigeria
Harnessing appropriate-scale farm mechanisation in Zimbabwe	CROP/2021/166	Zimbabwe
Adoption of conservation agriculture practices in selected sites in eastern Africa: Drivers, constraints and obstacles	CROP/2022/106	Kenya, Tanzania, Uganda
Demand-led plant variety design for emerging markets in Africa	FSC/2013/019	Ghana, Kenya, South Africa, Tanzania
Forestry		
Growing the future: Better forestry in Uganda	FST/2021/147	Uganda
Fruit trees for climate adaption and mitigation in East Africa	FST/2021/163	Kenya
Horticulture		
Developing a biosecurity system for small banana growers resilient to *Fusarium* wilt TR4 in southern and eastern Africa	HORT/2020/128	Mozambique, South Africa, Tanzania
Livestock Systems		
Resilient and low-carbon livestock systems for trade and food security in the rangelands of eastern and southern Africa	LS/2020/152	Ethiopia, Kenya, Zimbabwe
Upscaling the benefits of insect-based animal feed technologies for sustainable agricultural intensification in Africa (PROTeinAfrica)	LS/2020/154	Kenya, Rwanda, Uganda
Water		
Transforming smallholder irrigation into profitable and self-sustaining systems in southern Africa	LWR/2016/137	Malawi, Mozambique, South Africa, Tanzania, Zimbabwe
Virtual Irrigation Academy Phase 2: From water monitoring to learning to governance	WAC/2018/162	Malawi, Mozambique, South Africa, Zimbabwe
Information for agriculture and food security – Digital Earth Africa	WAC/2021/164	Eastern and southern Africa
CultiAF2		
Climate-smart interventions for smallholder farmers in Ethiopia (CultiAF 109038)	GP/2019/173	Ethiopia
User-driven approaches to make government and farmer led smallholder irrigation in Mozambique more productive (CultiAF 109039)	GP/2019/174	Mozambique
Alien invasive fruit flies in southern Africa: Implementation of a sustainable integrated pest mangement programme to combat their menaces (CultiAF 109040)	GP/2019/175	Malawi, Mozambique, Zambia, Zimbabwe
Harnessing dietary nutrients of underutilised fish and fish-based products in Uganda (CultiAF 109041)	GP/2019/176	Uganda
Improving agricultural productivity and resilience with satellite and cellphone imagery to scale climate-smart crop insurance (CultiAF 109076)	GP/2019/177	Kenya

Eastern and Southern Africa

A$8.2 million
Budgeted funding

22
Bilateral and regional research projects

4
Small projects and activities

The agricultural environments of eastern and southern Africa and northern Australia have much in common — the wet tropics of Rwanda with northern Queensland, the semi-arid tropics of eastern Africa with central Queensland, and the arid rangelands of Ethiopia and southern Africa with the Northern Territory.

Australian agricultural science has expertise that is directly relevant to the African context. For more than 3 decades, ACIAR has supported projects that mobilised this expertise to deliver sustainable development outcomes in the region. The free-market orientation and effective architecture of agricultural research in Australia are also relevant to African agricultural transformation.

The ACIAR program with eastern and southern Africa fills a niche not addressed by many donors: agricultural research-for-development. Our work is highly regarded and remains as relevant now as it was 30 years ago because of our research for development focus, ability to enable projects with a trans-disciplinary and cross institutional approach, the similarities of the agricultural environments between Australia and eastern and southern Africa, synergies built with Australia's world-class teaching and research institutions that advance African agriculture and our long-term commitment to address specific constraints in agricultural production, with multi-year projects.

We currently invest 10% of our annual budget in our Eastern and Southern Africa regional program and directly fund projects in partnership with 11 African countries. However, our footprint is much broader because of our contribution to the CGIAR, which has 4 of its centres located in Africa and, until recently, spent half of its total budget in Africa.

Our program is delivered primarily through bilateral country research partnerships (linked to regional impact pathways) and regional collaborations coordinated with sub-regional organisations. We also have a strong element of engagement through the CGIAR. The portfolio of projects covers a diverse range of priorities, guided by the recommendations of the regional research coordination bodies that we collaborate with.

We also have a substantial collaboration with Canada's International Development Research Centre through two programs: Cultivate Africa's Future Fund (CultiAF) that is focused on Africa, and the Food Loss Research Program that has a global reach with two of its projects being implemented in Africa. Now in its second phase and supporting 9 projects across 7 countries, CultiAF has been a highly regarded and somewhat unique program with Africa. Several CultiAF2 projects ended in 2021 and the overall program has recently undergone an external review whose results will inform the 2 agencies on ways forward and possibly provide options for additional work.

2022–23 research program

- **26 ACIAR-supported projects in eastern and southern Africa**
- **24 projects are specific to this country**
- **2 projects are part of regional projects**

The research program addresses our high-level objectives, as outlined in the ACIAR 10-Year Strategy 2018–2027, as well as specific issues and opportunities identified by ACIAR and our partner organisations. The following sections briefly describe individual ACIAR-supported projects and anticipated outputs in eastern and southern Africa. The projects are grouped according to research programs. Each project description is referenced in a list at the end of this section, which provides the project title and code.

Agribusiness

Zambia and Malawi are among the world's hungriest and fastest urbanising countries. The number of people facing food insecurity continues to rise, grabbing international attention in policy dialogues on food and nutrition security. One of the key strategies to address this hunger and nutrition challenge lies in food loss along the food value chain. With the demographic shift to cities and towns, food value chains now involve many actors that influence the way that food is produced, processed, distributed, marketed and consumed.

This situation has resulted in an increased number of actors, raised questions of actor responsibility and inefficiency (both resulting in increased food loss), increased cost of food and reduced nutrition security. Dr Gilbert Siame of the University of Zambia and Dr Mtafu Manda of Mzuzu University of Malawi lead 2 projects that seek to make an intervention at 4 stages of the fresh food value chain in selected cities in Zambia and Malawi to understand the drivers and implications of food loss at points of production, transportation, open-air markets and households. This project is part of the ACIAR–IDRC Food Loss Research Program (page 23).[1,2]

Sub-Saharan Africa is one of the fastest growing regions in the world, in terms of population growth and the number of undernourished people, making food insecurity a top challenge. 74% of Kenya's population live in rural areas and rely on farming to support livelihoods. The expansion of food production and supply is a priority of the Kenyan Government. A new project led by Ms Deb Doan of Business for Development will develop and trial a model for market-driven, collaborative value chains incorporating collective farming systems and intensive and circular agriculture principles to create sustainable and ethical production systems in the smallholder farming community of Kwale, Kenya. Critical success factors will be identified and implemented for adoption and scale-out by existing networks and institutions across Kenya.[3]

Dr Gilbert Siame of the University of Zambia (right), pictured with ACIAR Regional Manager, Dr Leah Ndungu, inspect a field site linked to a project where food loss is investigated at 4 points along the value chain. Photo: Emmie Wachira

ACIAR supports several projects in eastern and southern Africa to improve crop development, nutritive value and pest and disease tolerance of major food crops, including faba beans, mungbeans and lentils. Photo: Emmie Wachira

Crops

Nigeria produces about 44% of the world's cowpea, but it is also the largest importer of cowpea in Africa. Grown by millions of smallholder farmers, the crop is the main source of dietary protein and vital minerals such as iron in Nigeria. Most households consume cowpea in various cooked forms at least once a day. Pre-harvest infestation of pod borer can reduce production by up to 80%. A Bt-based pod borer-resistant cowpea developed by Dr TJ Higgins of CSIRO has been grown by farmers since 2021. The project will support a small field-based research activity by the African Agricultural Technology Foundation to assess the entomological effects and impact on agronomic practices and yield of the pod borer-resistant cowpea compared with conventional cowpea, determine the impact of growing pod-borer resistant cowpea on family workload and livelihood, and assess the opportunity for release of the pod borer-resistant cowpea in Ghana and Burkina Faso. The project will also assess the socio-economic performance of the new variety and the application of stewardship protocols along its value chain.[4]

Mungbean is an ideal rotation crop for smallholder farmers throughout the Indian Ocean Rim region. The International Mungbean Improvement Network, established through a project led by Dr Ramakrishnan Nair of the World Vegetable Center, helped realise the potential of mungbean to improve cropping system productivity and livelihoods by improving researchers' access to genetic material, and coordinating and providing technical support to variety development in Bangladesh, India, Myanmar and Australia. Phase 2 of the project extends the network to Kenya and Indonesia, expanding the source of germplasm to develop new mungbean varieties, as well as strengthening the capacity of more national mungbean breeding programs.[5]

Using new plant breeding methods, a project led by Professor Wallace Cowling of the University of Western Australia aims to deliver genotypes of the common bean (*Phaseolus vulgaris*) that have 30% shorter cooking time, 15% greater zinc and 10% greater iron content than current varieties. The new types will also have better resistance to bruchid beetle and *Pythium* root rot, and other improved agronomic trait. The project continues to train plant breeders in the Pan-Africa Bean Research Alliance, coordinated by the International Center for Tropical Agriculture, in accelerated plant breeding, based on recent developments in genetic data collection and analysis.[6]

Faba bean is the most important legume crop in Ethiopia, where pulses contribute 15% of the protein consumed. Faba bean gall disease threatens the ongoing cultivation, viability and existence of the crop in the highland areas of Ethiopia. A project led by Professor Martin Barbetti of the University of Western Australia continues to build knowledge of the disease, its distribution and its management. The project is delivering integrated disease management packages and extension packages to manage faba bean gall. In doing so, the project will increase the capacity of Ethiopian scientists and extension workers to address other plant disease issues using new methodologies and knowledge obtained through this project.[7]

Lentils are one of the main pulses consumed and an essential rotation cash crop for smallholders in cereal-based cropping systems of the mid-highlands of Ethiopia. Protecting the lentil crop and increasing its productivity is a priority for the Ethiopian Institute of Agricultural Research, as previously minor viral diseases have recently become high-impact epidemics. Professor Martin Barbetti of the University of Western Australia has mobilised the best expertise in Australia and the International Center for Agricultural Research in the Dry Areas to support Ethiopian lentil breeding and plant pathologists. In 2022–23, the project continues to identify germplasm with a high level of resistance to the target diseases and establish sustainable disease management practices for production systems in Ethiopia.[8]

A scoping study will be commissioned in eastern Africa to understand how conservation agriculture practices are known and evaluated by farmers around past experimental sites. The main aim of the study is to identify research questions about the interplay between conservation agriculture, small scale machinery and the integration of crop with livestock, to be addressed in a future project.[9]

Previous ACIAR projects in Zimbabwe showed the potential benefits of appropriate-scale mechanisation for productivity, resilience and reduced drudgery, enabling the adoption of climate smart intensification technologies (which tend to increase labour demands). The Government of Zimbabwe is now investing to support mechanisation, especially to mechanise the maize conservation agriculture practice locally known as Pfumvudza. Dr Frederic Baudron of CIMMYT is leading the project, which aims to support government and private sector investment in mechanisation, through better targeting, business intelligence, modelling alternative investment outcomes, coordination of stakeholders and the local and regional exchange of information.[10]

Demand-led plant variety design has the potential to transform plant breeding for small-scale agriculture and food security. A project facilitated by the Alliance for Agricultural Research and Development for Food Security (page 24) and led by Professor Kaye Basford of the University of Queensland engages with plant-breeding and university sectors in many countries. Phase 1 identified skills and processes needed for breeders to obtain high-performing plant varieties to meet the demands of emerging markets in Sub-Saharan Africa. Phase 2 provided more plant breeders with access to the program and focused on the implementation of best practice in demand-led plant-breeding programs for beans and tomatoes. The project concludes in 2023 with the strengthening of education and training programs for plant breeders across Africa to build capacity in demand-led variety design.[11]

Hybrid wheat has the potential to produce more grain from the same or less land, significantly contributing to food security and land sustainability. However, technical difficulties of hybrid wheat development and the high cost of hybrid seed have constrained the commercial development of new varieties for many decades. Professor Richard Trethowan of the University of Sydney leads a project that aims to extend the benefits of new hybrid wheat systems to researchers, wheat breeders, farmers and consumers in Pakistan, Bangladesh and Ethiopia. The university has developed a novel, cost-effective and practical system to rapidly produce large numbers of wheat hybrid combinations for testing in breeding programs, and to produce large amounts of hybrid seed for sale to farmers at an acceptable cost. The project will establish the performance of the hybrids, and determine effective technical processes and business models to produce the seed in collaboration with the national programs and local seed providers in each country.[12]

Previous ACIAR funded-projects established that agroforestry trees around homesteads and farms can underpin and improve food security and livelihoods. New research focuses on the potential to enhance farm-level climate adaptation and household food security through increased planting and strategic siting of fruit trees. Photo: Isaac Kasamani

Forestry

Uganda has experienced a sharp decline in forest cover, from 24% in 1990 to 9% in 2015. To mitigate this, the government has prioritised forest restoration, but forest cover continues to decline. A new project led by Dr Hillary Agaba of the National Forestry Resources Research Institute aims to improve the effectiveness of forest restoration in Uganda by identifying factors contributing to success or failure in current and recent forestry projects. The project will build the capacity of community-based organisations, NGOs and commercial forestry actors to conduct and analyse research while improving the returns on forestry investment.[13]

Previous ACIAR projects have established that adopting agroforestry trees around homesteads, farmers' fields and landscape niches in East Africa can provide products and services that underpin and improve food security and livelihoods. A new project led by Professor Catherine Muthuri of World Agroforestry aims to enhance farm-level climate adaptation as well as household food security and nutrition for smallholders in Kenya and Rwanda by increasing the stocking and strategic siting of fruit trees. Researchers will also explore the potential for the carbon sequestered in fruit trees to provide access to additional international climate finance.[14]

Horticulture

Fusarium wilt tropical race 4 (TR4) of bananas is caused by a highly destructive and invasive plant pathogen, the soil-borne fungus *Fusarium* sp. The disease, also called Panama disease, was first detected in Africa in 2013 in northern Mozambique, and further spread of the disease would be catastrophic. In eastern and central Africa, 70–100 million people rely directly or indirectly on bananas for their livelihoods. A new project led by Mr Stewart Lindsay of the Queensland Department of Agriculture and Fisheries aims to understand the vulnerabilities of banana farming systems in Mozambique and Tanzania and work with country partners and landholders to identify biosecurity measures to reduce risks and mitigate the damage in farmer fields. The project aims to build knowledge specifically for smallholder banana production systems to inform research, extension, regulatory and policy decisions more broadly in Africa, Asia and Latin America, where smallholder banana producers are common.[15]

Livestock Systems

Extensive livestock systems support the majority of Africa's livestock population, but many pastoralists experience chronic food, nutrition and economic insecurity. Furthermore, livestock account for almost 80% of total agricultural emissions in eastern Africa. In the rangelands of eastern and southern Africa, sociocultural practices and climate are not conducive to crop production.

Livestock are the lifeblood of these systems and the people that thrive within them. A new project focused on Ethiopia, Kenya and Zimbabwe will address knowledge gaps and identify emergent opportunities to increase livestock productivity and trade, while reducing greenhouse gas emissions. Dr Dawit Solomon of the International Livestock Research Institute will lead the project, which is structured around 4 key intervention areas: community-based rangeland management, small ruminant community-based breeding initiatives, animal health and increased off-take through livestock marketing.[16]

Through the INSFEED projects, which are part of CultiAF, the International Centre of Insect Physiology and Ecology and partners successfully demonstrated mass insect rearing on organic waste, resulting in both a proven animal protein source and organic fertiliser. Post-harvest technologies were established to ensure product shelf-life and safety, meeting national standards for the use of insects as ingredients in compounded feeds. Dr Chrysantus Tanga of the International Centre of Insect Physiology and Ecology leads a new project that starts with scaling up the production of insects and insect-based feed products through modular rearing systems. These systems are already established in Kenya and Uganda and will be assessed for Rwanda. Several storage techniques will be investigated for their potential to improve both shelf and on-farm storage conditions in Kenya.[17]

Dr Anna Okello, ACIAR Livestock Systems RPM and the ACIAR Africa team visited Riverside Farm in Embu, Kenya. The farm is a commercial pig production enterprise that rears black soldier flies larvae using pig manure as the substrate. Photo: Emmie Wachira

Water

Smallholder farmers in southern Africa require new irrigation management skills to realise the benefits and potential of available irrigation infrastructure. Phase 1 of the Virtual Irrigation Academy project in Malawi, South Africa and Tanzania developed a system of continual social and institutional learning to improve the profitability and sustainability of irrigated farming. Phase 2 of the project, led by Dr Richard Stirzaker of CSIRO, will develop the Virtual Irrigation Academy system into a water learning and governance platform to support smallholder farmers and address the information deficits at scheme to national levels. In 2022–23, the rollout of the Virtual Irrigation Academy will be supported across irrigation schemes in Malawi, Mozambique and Zimbabwe. An assembly facility for the production of the Chameleon sensor, and training for repairs to the device, will be set up on Malawi.[18]

Irrigation has significant potential to contribute to food security in Sub-Saharan Africa, but many irrigation schemes are under-performing and returns on investment in irrigation infrastructure are low. The Transforming Irrigation in Southern Africa (TISA) project, led by Professor Jamie Pittock of the Australian National University, has involved irrigation schemes supporting more than 15,000 farmers in Mozambique, Zimbabwe and Tanzania. Due to be completed in 2023, the project has introduced soil and water management technologies that have increased the productivity and incomes of farmers and made irrigation schemes more self-sustaining. In its final year, the project will report on the best methods for dissemination of technologies and identify the factors leading to inequity among farmers in water supply and financial benefit from irrigation schemes.[19]

Earth Observation-based services are increasingly being identified as an essential enabler in addressing food security, both in Africa and the world over. To support more effective and sustainable use of water resources for food security, food system managers in Africa require awareness and easy access to such services. A new project, led by Dr Cedric Jorand of Geoscience Australia, in partnership with the Association for Strengthening Agricultural Research in Eastern and Central Africa aims to support consultations with African agricultural and water management agencies to understand the needs, opportunities and gaps for using Earth Observation-based services to increase agricultural productivity and sustainability, including through improved water use. In doing so, the project will develop a roadmap for Digital Earth Africa to deliver services tailored to these needs, to improve productivity and build resilience.[20]

CultiAF2 projects

Climate change is causing a higher frequency of drought and crop failures in Ethiopia's dry lowlands, exposing farmers to food shortages and livestock losses due to a lack of feed. Dr Taye Mindaye of the Ethiopian Institute of Agricultural Research leads a project, which started with CultiAF2, to develop and implement technologies that reduce the risk of crop failure, increase crop productivity and create new business opportunities for women. The focus is on technologies associated with sorghum production, such as drought-tolerant varieties and small-scale threshers.[21]

Inefficiency constrains the performance of government and farmer-led smallholder irrigation schemes in Mozambique. A CultiAF2 project led by Dr Mario Chilundo of the University of Eduardo Mondlane, Mozambique, aims to equip farmers with the resources and skills to sustain such schemes and identify institutional strategies to support government rehabilitation and expansion programs. The project will combine technical (soil and water management practices), social (business plans and market linkages) and institutional (innovation platforms and water-user associations) innovations and compare changes in their management, productivity and profitability for farmers. Gender analysis and scenario planning will be conducted to inform the design of user-driven, equitable and gender-responsive approaches for schemes that are inclusive of all users.[22]

High-value horticultural crops are key drivers of economic development in Sub-Saharan Africa. Fruit crops can return a higher income than staple crops, and they provide more employment opportunities for smallholders both on and off the farm, especially women. Fruit-fly infestations reduce the quality and quantity of fruit, curtailing lucrative export opportunities and increasing the use of synthetic insecticides. Dr Samira Mohamed of the International Centre of Insect Physiology and Ecology, Kenya, will lead a project to adapt and promote the widescale adoption of integrated pest-management interventions in Malawi, Mozambique, Zambia and Zimbabwe.[23]

Nutritional deficiencies are widespread in Uganda's poor rural and urban communities, particularly in women of reproductive age and children under 5 years, due to limited access to animal protein and micronutrient-rich foods, especially fish. Dr Jackson Efitre of Makerere University, Uganda, leads the NutriFish project and works with the fish sector and its associated value chains to address the nutritional needs of vulnerable groups. NutriFish aims to increase the availability, accessibility and consumption of underused fish to improve sustainable food and nutrition security and improve the livelihoods of vulnerable groups. It also aims to increase by-product processing through public–private partnerships.[24]

Crop insurance is an option for farmers to protect their livelihoods against losses, as climate changes and extreme weather events become more frequent. However, very few insurance schemes are suitable for smallholder farmers. The high monitoring and verification costs of traditional insurance, the low demand for index-based insurance and the lack of complementary risk-management options (such as irrigation and drought-tolerant cultivars) are constraints for farmers in Kenya. Mr Amos Tabalia of Agriculture and Climate Risk Enterprise Limited leads a project to rigorously evaluate insurance packages and promote technologies to make farming systems more resilient. This project focuses on technologies such as satellite and cell phone imagery to verify crop losses and observe management practices.[25]

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See page 186 for contact details.

Current and proposed projects

1. Managing food value chains for improved nutrition for urban vulnerable populations in Mzuzu City (Malawi) (AfricitiesFood) (CS/2021/115)
2. Managing food value chains for improved nutrition for urban vulnerable populations in Lusaka City (Zambia) (AfricitiesFood) (CS/2020/210)
3. Kwale Agricultural Research for Development Project, Kenya (AGB/2021/123)
4. Australian technology reaches the field: Supporting and monitoring the release of pod-borer resistant cowpea [Nigeria] (CROP/2021/165)
5. International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)
6. Rapid breeding for reduced cooking time and enhanced nutritional quality in common bean (*Phaseolus vulgaris*) [Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda] (CROP/2018/132)
7. Faba bean in Ethiopia: Mitigating disease constraints to improve productivity and sustainability (CIM/2017/030)
8. Protecting Ethiopian lentil crops (CROP/2020/164)
9. Adoption of conservation agriculture practices in selected sites in eastern Africa: Drivers, constraints and obstacles [Kenya, Tanzania, Uganda] (CROP/2022/106)
10. Harnessing appropriate-scale farm mechanisation in Zimbabwe (CROP/2021/166)
11. Demand-led plant variety design for emerging markets in Africa [Ghana, Kenya, South Africa, Tanzania] (FSC/2013/019)
12. Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan (CROP/2020/167)
13. Growing the future: Better forestry in Uganda (FST/2021/147)
14. Fruit trees for climate adaption and mitigation in East Africa [Kenya] (FST/2021/163)
15. Developing a biosecurity system for small banana growers resilient to *Fusarium* wilt TR4 in southern and eastern Africa [Mozambique, South Africa, Tanzania] (HORT/2020/128)
16. Resilient and low-carbon livestock systems for trade and food security in the rangelands of eastern and southern Africa [Ethiopia, Kenya, Zimbabwe] (LS/2020/152)
17. Upscaling the benefits of insect-based animal feed technologies for sustainable agricultural intensification in Africa (PROTeinAfrica) [Kenya, Rwanda, Uganda] (LS/2020/154)
18. Virtual Irrigation Academy Phase 2: From water monitoring to learning to governance [Malawi, Mozambique, South Africa, Zimbabwe] (WAC/2018/162)
19. Transforming smallholder irrigation into profitable and self-sustaining systems in southern Africa [Malawi, Mozambique, South Africa, Tanzania, Zimbabwe] (LWR/2016/137)
20. Information for agriculture and food security – Digital Earth Africa [Eastern and southern Africa] (WAC/2021/164)
21. Climate-smart interventions for smallholder farmers in Ethiopia (CultiAF 109038) (GP/2019/173)
22. Improving agricultural productivity and resilience with satellite and cellphone imagery to scale climate-smart crop insurance (CultiAF 109076) [Kenya] (GP/2019/177)
23. Alien invasive fruit flies in southern Africa: Implementation of a sustainable integrated pest management programme to combat their menaces (CultiAF 109040) [Malawi, Mozambique, Zambia, Zimbabwe] (GP/2019/175)
24. User-driven approaches to make government and farmer led smallholder irrigation in Mozambique more productive (CultiAF 109039) [Mozambique] (GP/2019/174)
25. Harnessing dietary nutrients of underutilised fish and fish-based products in Uganda (CultiAF 109041) (GP/2019/176)