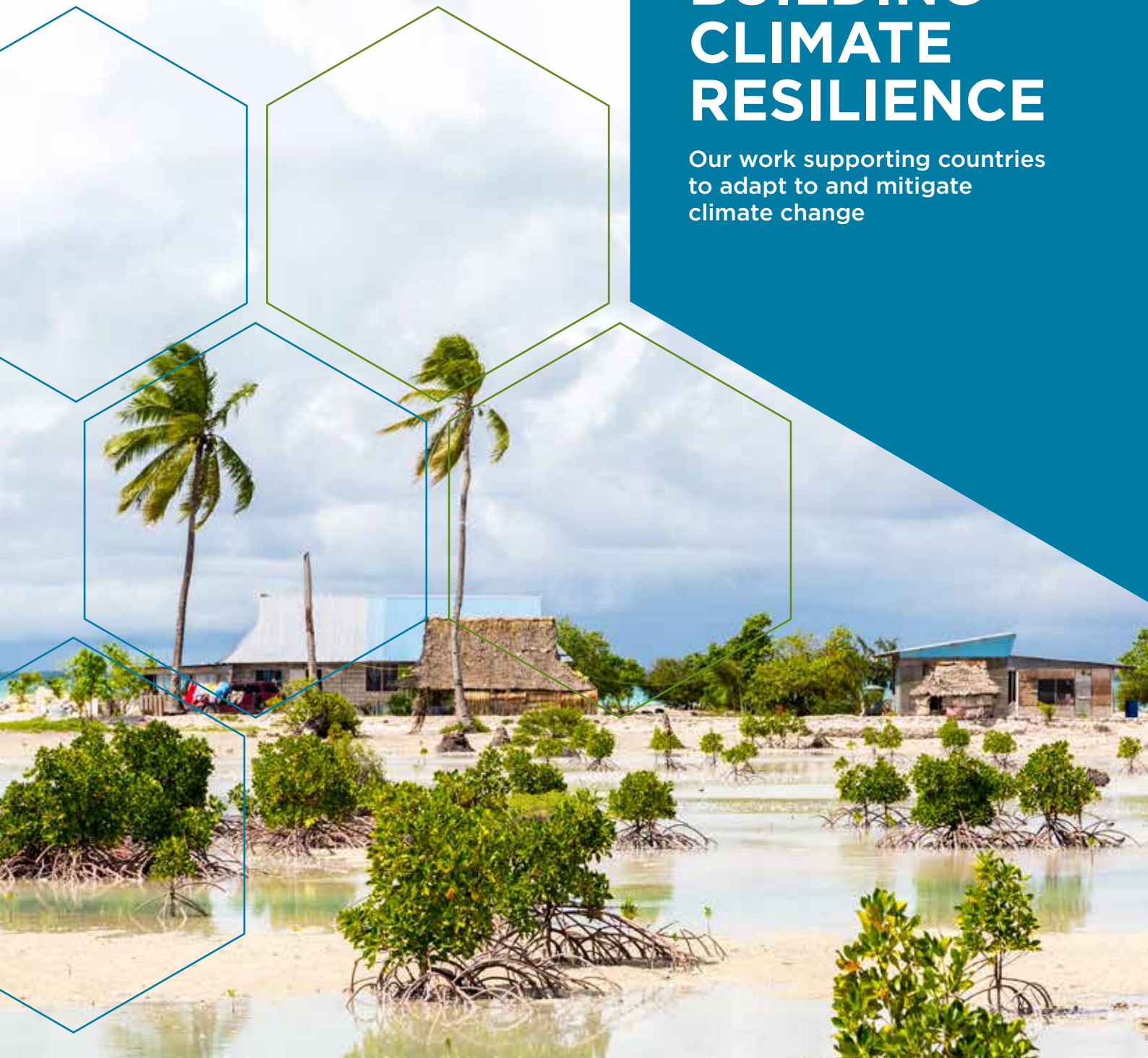




Australian Government
**Australian Centre for
International Agricultural Research**

BUILDING CLIMATE RESILIENCE

Our work supporting countries
to adapt to and mitigate
climate change



Overview

Climate change and extreme weather events are already affecting agricultural production and threatening food security in tropical and temperate regions. The hardest hit are the rural poor, who mostly depend on agriculture for their livelihoods.

Agriculture contributes almost a quarter of global greenhouse gas emissions, so the sector has a major role to play in responding to climate change. There is great potential to make significant contributions through reductions in emissions and sequestration of greenhouse gases.

While the aggregate emissions of low-income countries tend to be lower than industrialised countries, agriculture often generates a high proportion of their emissions and is crucial if they are to meet their own global commitments.

Responding effectively to the impacts of climate change is a major challenge that will require global efforts and partnerships to implement policies and actions that promote more sustainable and resilient agricultural systems.



Agriculture plays a major role

More than 3 billion people, 80% of the poor, live in rural areas, with around 2.5 billion dependent on agriculture for their livelihood (FAO)



Greenhouse gases

Agriculture contributes almost a quarter of global greenhouse gas emissions (IPCC)



Damage/loss

26% of all climate-related disaster damage and loss is absorbed by the agriculture sector (FAO)





Our climate program

For more than 35 years, ACIAR has brokered partnerships between researchers from Australia and the developing world to generate the knowledge and technologies needed to build healthier, more prosperous and resilient communities.

Two-thirds of ACIAR projects are climate-related. The organisation is well positioned to support countries to confront the global challenge of adapting to a changing climate, while at the same time reducing emissions from agriculture.

ACIAR partners with leading Australian research institutions to:

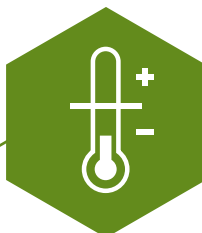
- » Support low- and middle-income countries to tackle climate impacts in agriculture, in line with their national plans and strategies
- » Build linkages between top Australian researchers and their counterparts in developing countries to better adapt to changing climates, and to understand, measure and mitigate emissions
- » Strengthen Australia's own agricultural climate change capabilities through trialling innovative approaches.
- » Implement the ACIAR Gender Policy and Strategy to address the differential impacts of climate adaption and mitigation on female and male farmers to increase gender equality.

The Climate program focuses on providing expertise and information on three key areas - **adaptation, mitigation and global engagement** - across all ACIAR research investments, to improve our understanding of current and future risks from the impacts of climate change.



Adaptation

Develop innovative transformational adaptation responses that increase resilience of smallholder farmers



Mitigation

Identify and provide realistic options to deliver meaningful emissions reductions in agriculture



Global engagement

Collaborate, share knowledge and provide expertise and resources in agricultural research to assist developing countries

A key global partner

ACIAR is a global leader in developing and delivering international agricultural research partnerships in developing countries to achieve more productive and sustainable agricultural, fisheries and forestry systems.

ACIAR leads Australia's engagement in the Global Research Alliance on Agricultural Greenhouse Gases and the CGIAR research program on Climate Change, Agriculture and Food Security. ACIAR also participates on other national and international climate change forums, enabling Australian scientists to achieve results that would be more difficult working in isolation. The forums also work to develop options and capacity for meaningful adaptation and emissions reductions in smallholder agriculture.

The Australian Government's involvement in international negotiations on climate change has sought to encourage and establish world-wide consistency in greenhouse gas measurement, reporting and verification for agriculture and the land sector. This continues to be a cornerstone of Australian contributions.

ACIAR represents
Australia on the
Global Research Alliance
on Agricultural
Greenhouse Gases



Supporting countries to implement their Paris Agreement commitments

In December 2015, Australia became a signatory to the Paris Agreement, which brought to light potential implications for the agriculture sector.

With around 90% of countries now committed to addressing and reporting emissions from agriculture in their Nationally Determined Contributions (NDCs), we need to invest in research that can identify and provide realistic and cost-effective options for countries to deliver emissions reductions in a way that is meaningful for smallholder farmers.

Australia is well placed to lead concerted regional action to address the effects and opportunities of climate change and develop regional capacity to implement the Paris Agreement. ACIAR climate projects are working to build regional capacity to reduce agricultural emissions, and to measure, report, verify and manage emissions to meet NDCs under the Paris Agreement.

Working together with the Department of Foreign Affairs and Trade (DFAT), ACIAR is developing jointly-funded projects that assist countries in our region to improve tools, methods and capacity for **identifying, quantifying, prioritising and mitigating** net greenhouse emissions in agriculture. This work will help developing countries to quantify and maximise the potential of their agricultural, land and forestry sectors to help meet their NDCs.

Australian research institutions have world class capabilities across a broad range of biological, agricultural and social sciences relevant to mitigating and adapting to climate change.

Sharing innovation

ACIAR sits at the intersection of Australian innovation in agricultural research and its diplomatic outreach. It has a strong track record of bringing Australian and international researchers together to develop solutions to improve sustainable agricultural productivity.

Australian research institutions have world class capabilities across a broad range of biological, agricultural and social sciences relevant to mitigating and adapting to climate change. Since 2008, around A\$200 million has been invested in agricultural climate change research domestically.

This research has developed some of the world's most sophisticated and effective methodologies for accounting and reporting of emissions. Innovative programs such as the Climate Change Research Strategy for Primary Industries, the Climate Change Research Program, the Managing Climate Variability Program, the Carbon Farming Futures Program, the Climate Change Adaptation Research Facility and the Emissions Reduction Fund have fostered the development of innovative methods and tools to more effectively tackle the converging threats from climate change and unsustainable use of natural resources.

ACIAR climate initiatives

In close collaboration with its partners, ACIAR works to make agriculture, fisheries and forestry more productive and sustainable in the Indo-Pacific region.

A\$150 million
investment in
130 projects
that are climate related

*(2015-2019)

15%

of projects in
South Asia

5%
of projects in
Eastern & Southern
Africa

KEY

Pacific

- 1 Fiji
- 2 Kiribati
- 3 Papua New Guinea
- 4 Samoa
- 5 Solomon Islands
- 6 Timor-Leste
- 7 Tonga
- 8 Tuvalu
- 9 Vanuatu

East and South-East Asia

- 10 Cambodia
- 11 China
- 12 Indonesia
- 13 Laos
- 14 Mongolia
- 15 Myanmar
- 16 Philippines
- 17 Thailand
- 18 Vietnam

South Asia

- 19 Bangladesh
- 20 India
- 21 Nepal
- 22 Pakistan
- 23 Sri Lanka

Eastern and Southern Africa

- 24 Burundi
- 25 Ethiopia
- 26 Kenya
- 27 Malawi
- 28 Mozambique
- 29 Rwanda
- 30 South Africa
- 31 Tanzania
- 32 Uganda
- 33 Zambia
- 34 Zimbabwe

Ghana (not shown)



50%
of projects in
East & South-East
Asia

ACIAR is increasing its focus in the Pacific. Key areas include:

- » **Growing partnerships** that develop capability in the Pacific to plan for and adapt to climate change impacts on agriculture; plans that are in-country, region-based, commodity-based, and include the most vulnerable subsistence farmers and their communities.
- » **Promoting investment** in collaborative research that identifies options for Pacific nations to sustainably increase productivity, while improving food security and providing more resilient livelihoods.
- » **Building capacity** of Pacific countries to participate in international climate change research activities and the knowledge and skills of their researchers.

30%
of projects in
Pacific

Examples from the field

PACIFIC

Supporting Asia-Pacific countries to reduce emissions from agriculture

Location: **Fiji and Vietnam**

Many countries in the Asia-Pacific region are not able to deliver on their NDCs under the Paris Agreement in a cost-effective and sustainable way. This is due to a lack of locally-appropriate agricultural emission-reduction or offset options; a lack of accounting methods that can recognise and capture these emission-reductions; and short-falls in capacity, inventory information and systems. In response, this project is identifying mitigation options and key capacity development needs in the agriculture sector to support both Fiji and Vietnam in meeting their NDCs.

This includes an assessment of the role of smallholders and the potential impacts on food and income security. Leveraging the success of recent Australian mitigation and adaptation research, carbon farming offset methods and other emission-reduction research internationally, the project will develop realistic plans for implementing mitigation options for optimising emissions reductions – while maintaining smallholder farmers income and food security.



Understanding the responses of taro and cassava to climate change

Location: **Fiji and Vanuatu**

Pacific island communities, reliant on agriculture-based livelihood systems, are particularly at risk from climate change. Shortfalls in agricultural production resulting from changing export markets, commodity prices, climatic variation, and population growth and urbanisation, have contributed to regional food insecurity concerns. Several activities are underway in the Pacific region to identify ways to ameliorate existing climate risk and enhance agricultural production.

These activities are important to ensure long-term agricultural sustainability, but it is uncertain how effective these strategies will be in the face of a changing and increasingly variable future climate. In response, this project sought to understand the impact of near-term climate change on key Pacific production systems – specifically those based on the staple root crops, taro and cassava. An agricultural production systems simulator modelling (APSIM) framework was used to develop crop modules to identify strategies for farming systems adaptation.

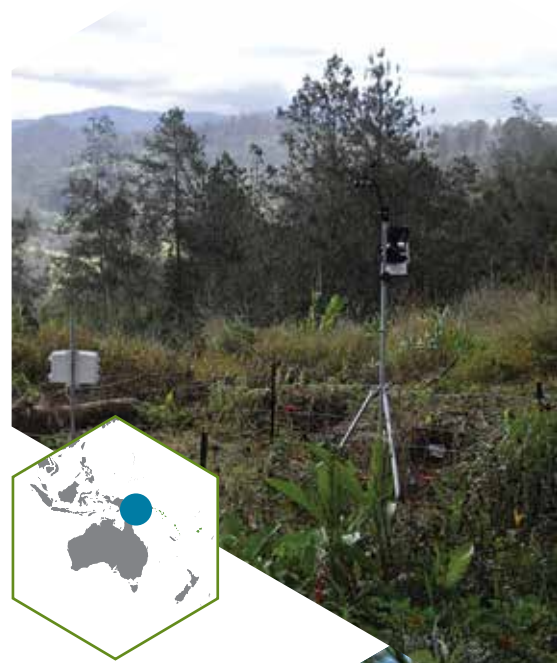


Developing climate-smart agriculture opportunities for enhancing food production

Location: **Papua New Guinea**

Communities in Papua New Guinea (PNG) reliant on agriculture-based livelihood systems are at risk from climate variability and change. Making strategic food production plans ahead of evolving seasonal climate conditions is seen as an important way to improve the resilience of food production systems. Seasonal climate forecast information is one tool that has been identified as aiding adaption responses to seasonal climate variability, however its use in rural community food production is challenging due to the complex nature of the information.

This project will examine ways in which seasonal climate information, with a three to six-month lead-time, can be communicated and integrated with existing farm practices to increase the adaptive capacity of farmers in five sites in PNG across three regions: Eastern Highlands centred on Aiyura and the Asaro Valley; the Morobe Province centred on the Markham Valley; and Kerevat in East New Britain.



Improving soil health, agricultural productivity and food security on atolls

Location: **Kiribati and Tuvalu**

Atolls of the Pacific islands are among the most vulnerable communities to the impacts of climate change and are facing major challenges to their food and income security.

Malnutrition is a significant concern and non-communicable diseases (diabetes, heart disease and micronutrient deficiencies) are increasingly evident as awareness of the effect of poor diet is low. Diets in Kiribati and Tuvalu have traditionally been based on fish and other marine animals and heavy on starch (giant swamp taro and breadfruit), with some fruits but few vegetables.

Agricultural production in both countries is restricted by lack of seeds, water shortages and salinity, poor soils, lack of tools and knowledge of farming practices, and limited guidance from extension services. As a result of limited agricultural production, Kiribati and Tuvalu consume more than they produce.

This project aims to improve the livelihoods of the people living in Kiribati and Tuvalu through sustainably increasing the productivity of starchy staple food production systems; increasing household and community production and consumption of local nutritious foods; and identifying opportunities for inter-island trade in high-value crops and products.



Examples from the field

SOUTH-EAST ASIA

Providing action-ready climate knowledge to improve disaster risk management for smallholder farmers

Location: **Philippines**

Smallholder farmers in the Philippines have always been vulnerable to extreme weather events and year-to-year climate variability. There is growing interest in understanding how agricultural development can draw on lessons from disaster risk management to minimise climate-related damage and build more climate-resilient farming systems.

The country's meteorological agency, PAGASA, has the international support and internal skills and resources to provide an expanding set of weather and climate information.

The challenge is to improve the use and usefulness of this information by smallholder farmers. In response, this project is working to improve the value of information flows between the Philippines' meteorological agency PAGASA and key decision-makers involved in managing climate and weather risk of smallholder farmers.

Through the use of applied socio-economics, this project will seek to understand the decision-making context, establish the potential value of information; observe the barriers to use of information; and research ways to improve communication and use.



Helping to maintain carbon in the soil

Location: **Indonesia**

Peatland restoration has become a high priority in Indonesia, due to the devastating effects of peat fires on local and regional public health and economies. Restoring degraded peatlands is doing the heavy lifting in Indonesia's plan to meet its NDCs. The Indonesian Peatland Restoration Agency is mandated to restore 2 million hectares of degraded peatlands by 2020, however an estimated 7 million hectares of degraded peatlands await restoration. In order to pursue successful and cost-efficient approaches in the short- to medium-term and adapt and refine less successful restoration techniques, restored peatlands need to be meaningfully monitored and assessed.

In response, this project will trial techniques to monitor restoration success, enabling cost-efficient and effective roll out of the best practise restoration over Indonesia's remaining degraded, regularly burning peatlands.

This will contribute to Indonesia's ability to monitor and reduce its greenhouse gas footprint via peat forest management and restoration, which will have national and international benefits. This project is working alongside an ACIAR Forestry project that is restoring peatland environments and reducing incidents of fire in Indonesia.



Developing more climate-resilient farming systems

Location: **Vietnam**

In a changing climate, farming systems will need to be more resilient to extreme weather events, and agroforestry can help to achieve this. In the northwest of Vietnam, the predominant farming system practised on large areas of very steep land involves monocropping of hybrid maize, which is mostly used for animal feed. This approach results in widespread soil erosion, a progressive decline in crop productivity and ongoing degradation of remnant forests.

Since 2010, this project has been helping farmers in the northwest of Vietnam use agroforestry to prevent soil erosion and reduce poverty. In partnership with the World Agroforestry Centre, the project has developed eight market-based agroforestry systems that enables farmers to diversify, reduce erosion and achieve higher incomes – contributing to addressing the region's poverty, deforestation and land degradation challenges.



Safeguarding food security in Myanmar's Dry Zone

Location: **Myanmar**

Food insecurity is a constant threat to the 12 million people living in the Central Dry Zone (CDZ) of Myanmar.

The region's annual rainfall has halved since the 1950's and droughts are stretching for longer periods, making increasing crop productivity a major challenge for the smallholder farmers that call the region home. With nearly half of the country's pulse and oilseed legumes and three-quarters of sesame and sunflower produced in the CDZ, safeguarding the future of the region against an increasingly turbulent climate has been a priority.

ACIAR, together with funding from the DFAT, supported work with Myanmar's Department of Agricultural Research to increase productivity of legume-based farming systems. During the five-year project, a total of 54 researcher-managed trials took place and an additional 378 smaller trials were run by local farmers. To date, these trials have led to eight new varieties of drought and disease-resistant legumes, the establishment of nearly 1,600 seed banks benefitting over 80,000 farmers, improved fertiliser and nutrient management practises and significant investments in developing Myanmar's soil research capacity.



Examples from the field

SOUTH ASIA

Building sustainable and resilient farming systems.

Location: **Bangladesh, India, Nepal**

The Eastern Gangetic Plains (EGP) of Bangladesh, India and Nepal is home to 300 million people, with the world's highest concentration of rural poverty and a strong dependence on agriculture for food security and livelihoods. Thanks to good water resources, the region has the potential to become a major contributor to South Asian regional food security. Low rice and wheat productivity and limited diversification lead to smallholder vulnerability. In addition, climate and market risks limit farmer and private sector investments in productivity-enhancing technologies.

In response, this project designed, adapted and demonstrated Conservation Agriculture-based Sustainable Intensification (CASI) practices, and has demonstrated the multiple economic, resilience and climate benefits of adopting CASI practices. Establishing dry season crops of maize, wheat or pulses with minimum tillage saves time, labour and energy, and reduces risk. Multi-stakeholder innovation platforms of various kinds are now scaling out the practices, with increasing support from national government agencies.



Restoring forests and landscapes

Location: **Nepal**

More than half of the population of Nepal lives off a combination of agriculture and forest products. However, low productivity and limited marketing opportunities, along with inequitable centralised planning and service delivery prevent forestry systems from providing adequate livelihoods. For more than 50 years, Australian aid has been supporting forestry research in the mid-hills region of Nepal and since 2013, ACIAR has continued this support and re-engaged with Nepal's community forestry sector.

The project, known as EnLiFT, brought together researchers from two Australian universities, the World Agroforestry Centre in Indonesia, and Nepalese non-governmental organisations to work with farmers and community forest organisations through silviculture to enhance the capacity of household agroforestry systems and community forests. Through the project, 2.4 million farmers and 19,700 forestry groups have been able to generate livelihoods and improve their food security. Reforestation efforts catalysed by this project have also significantly increased forest cover across the region.

Improving groundwater productivity and sustainable water management

Location: **India**

India depends on groundwater from wells for drinking water and irrigation, but this essential resource is being depleted by population growth and unpredictable monsoon rains. In many rural communities, the shortage of groundwater is constraining food production. To address this, ACIAR partnered with Western Sydney University to develop a village-level participatory approach to assist in improving groundwater supplies and reduce its demand through the direct involvement of farmers and other affected stakeholders.

A unique feature of the project was the use of scientific measurements by citizens through the engagement of Bhujal Jankaars (BJs), a Hindi word meaning 'groundwater informed' volunteers. Through training and capacity building, BJs monitored groundwater levels and quality to determine what was happening to groundwater availability at the village level. Part of the innovative project was also the development of the MyWell app for smartphones that enables the crowdsourcing and verification of groundwater-related data so farmers can self-manage groundwater sustainably at the village level and at the municipal council levels.



Sustainably increasing crop productivity

Location: **Bangladesh and West Bengal, India**

The coastal zones of Bangladesh and West Bengal in India are home to millions of the world's poorest and most vulnerable people, about 65% of whom live below the poverty line and rely mainly on agriculture for their livelihood. Agricultural productivity is low because farmers primarily grow low-yielding late-maturing traditional varieties of rice during the wet season and during the dry season much of the land lies fallow.

This project is working to sustainably increase cropping intensity and productivity in the region, particularly in the dry season, through integrated soil, water and crop management. The project is a collaboration between CSIRO and Murdoch University in Australia, and several Bangladeshi and Indian research organisations and universities, local non-government organisations, officials and farmers.



EASTERN & SOUTHERN AFRICA

Introducing a livestock component to the System for Land-Based Emissions Estimation (SLEEK)

Location: **Kenya**

Forests and agriculture are inherently linked, particularly in mixed landscapes and where land use and management practices change regularly based on climate, market opportunities and political/social structures. Despite this, there have been relatively few efforts to create integrated greenhouse gas emissions estimation systems for the land sector. Instead, each component, such as forests, crops and livestock grazing, is estimated using independent methods and data.

To address this, the project is designing and testing options for linking an operational livestock model to an existing integrated system for estimating greenhouse gas emissions from forests and agriculture: the System for Land-based Emissions Estimation for Kenya (SLEEK). This will be done by linking the existing SLEEK data (such as soils and climate), models (prototype pasture growth) with a Tier 2 livestock model and data using the SLEEK integration system (Full Lands Integration Tool). This innovative work will not only directly support Kenya but will provide other countries with a generic framework and operational example they can also use.



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Transforming irrigation into profitable and self-sustaining systems

Location: **Mozambique, Tanzania, Zimbabwe**

In an Australian-African collaboration, scientists are helping to ensure the precious commodity of water is used efficiently in drought-prone southern Africa. Combining Australia's CSIRO expertise with their Virtual Irrigation Academy (VIA), this project brings together new irrigation monitoring tools - the Chameleon Soil Water Sensor and the FullStop Wetting Front Detector - with an online communication and learning system to promote efficient and cost-effective irrigation.

To date, the combined technology has reduced water usage by 50% in pilot schemes in Malawi and Tanzania by extending the intervals between irrigation. Instead of irrigating four to five times a month, smallholders are now irrigating only once or twice a month. Less frequent irrigation means smallholders have more time to devote to grazing livestock, cultivating other crops and, for some women, building off-farm businesses to generate more family income.



Creating more productive, resilient, profitable and sustainable farming systems in the context of climate change.

Location: **Ethiopia, Kenya, Malawi, Mozambique, Tanzania**

One of ACIAR's flagship projects – the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) – has been addressing the challenges of intensifying the low productivity agroecosystems of the region. Over the past nine years, SIMLESA and other aligned projects have established, demonstrated and scaled out conservation agriculture-based sustainable intensification (CASI) practices increasing the productivity of maize-legume systems. This included the adoption of improved varieties of maize (40 releases) and legume (64 releases); intercropping or rotation

of maize with legumes; weed control and judicious use of herbicides; appropriate application of organic and inorganic fertilisers; limited soil disturbance for crop establishment and the use of crop residues as mulch. The project demonstrated the resilience to climate variability associated with the improved practices, the economic benefits to farmers from time and labour savings and increased productivity, as well as the environmental benefits from reduced soil erosion. SIMLESA also piloted the establishment of 58 innovation platforms that are providing key learnings about effective strategies to scale out transformative complex practices towards adaptation to, and mitigation of, climate change.



Building capacities for an integrated monitoring, reporting and verification system in the livestock sector

Location: **Ethiopia**

Ethiopia is addressing climate change through its Climate Resilient Green Economy (CRGE) strategy and is the basis for Ethiopia's nationally determined contributions under the Paris Agreement. Measurement, reporting and verification (MRV) of CRGE implementation progress and its climate effects in each sector, including livestock, is critical to enable Ethiopia to leverage additional climate finance investment as well as for informing domestic policies and meeting the country's international obligations. As an initial step, this project will focus on strengthening livestock MRV systems, including the national greenhouse gas inventory and CRGE MRV systems.

Embedded within a Climate Change and Food Security Programme of the CGIAR (CCAFS) – and working in partnership with the World Bank, the Global Research Alliance and other development partners – this project will target priority data needs identified in the CCAFS project to support improvements in methods and procedures used to produce and manage the livestock activity data required for MRV.



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