

# 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).<sup>1,2</sup>

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.<sup>3</sup>



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.<sup>4</sup>

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.<sup>5</sup>

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.<sup>6</sup>

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.<sup>7</sup>

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.<sup>8</sup>



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.<sup>9</sup>

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.<sup>10</sup>

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.<sup>11</sup>

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.<sup>12</sup>



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.<sup>13</sup>

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.<sup>14</sup>

## 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.<sup>15</sup>

## 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.<sup>16</sup>

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.<sup>17</sup>



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.<sup>18</sup>

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.<sup>19</sup>

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.<sup>20</sup>

## 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.<sup>21</sup>

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.<sup>22</sup>

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.<sup>23</sup>

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.<sup>24</sup>



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.<sup>25</sup>

### Regional Manager, Eastern & Southern Africa

Dr Leah Ndungu

### Research Program Managers

Agribusiness: Mr Howard Hall

Climate: Dr Veronica Doerr

Crops: Dr Eric Huttner

Forestry: Dr Nora Devoe

Horticulture: Ms Irene Kernot

Livestock Systems: Dr Anna Okello

Water: Dr Neil Lazarow

CultiAF: Dr Anna Okello

See page 186 for contact details.

## Current and proposed projects

- Managing food value chains for improved nutrition for urban vulnerable populations in Mzuzu City (Malawi) (AfricitiesFood) (CS/2021/115)
- Managing food value chains for improved nutrition for urban vulnerable populations in Lusaka City (Zambia) (AfricitiesFood) (CS/2020/210)
- Kwale Agricultural Research for Development Project, Kenya (AGB/2021/123)
- Australian technology reaches the field: Supporting and monitoring the release of pod-borer resistant cowpea [Nigeria] (CROP/2021/165)
- International Mungbean Improvement Network 2 [Bangladesh, India, Indonesia, Kenya, Myanmar] (CROP/2019/144)
- Rapid breeding for reduced cooking time and enhanced nutritional quality in common bean (*Phaseolus vulgaris*) [Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda] (CROP/2018/132)
- Faba bean in Ethiopia: Mitigating disease constraints to improve productivity and sustainability (CIM/2017/030)
- Protecting Ethiopian lentil crops (CROP/2020/164)
- Adoption of conservation agriculture practices in selected sites in eastern Africa: Drivers, constraints and obstacles [Kenya, Tanzania, Uganda] (CROP/2022/106)
- Harnessing appropriate-scale farm mechanisation in Zimbabwe (CROP/2021/166)
- Demand-led plant variety design for emerging markets in Africa [Ghana, Kenya, South Africa, Tanzania] (FSC/2013/019)
- Accelerating genetic gain in wheat through hybrid breeding in Bangladesh, Ethiopia and Pakistan (CROP/2020/167)
- Growing the future: Better forestry in Uganda (FST/2021/147)
- Fruit trees for climate adaption and mitigation in East Africa [Kenya] (FST/2021/163)
- 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)
- 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)
- Upscaling the benefits of insect-based animal feed technologies for sustainable agricultural intensification in Africa (PROTeinAfrica) [Kenya, Rwanda, Uganda] (LS/2020/154)
- Virtual Irrigation Academy Phase 2: From water monitoring to learning to governance [Malawi, Mozambique, South Africa, Zimbabwe] (WAC/2018/162)
- Transforming smallholder irrigation into profitable and self-sustaining systems in southern Africa [Malawi, Mozambique, South Africa, Tanzania, Zimbabwe] (LWR/2016/137)
- Information for agriculture and food security - Digital Earth Africa [Eastern and southern Africa] (WAC/2021/164)
- Climate-smart interventions for smallholder farmers in Ethiopia (CultiAF 109038) (GP/2019/173)
- Improving agricultural productivity and resilience with satellite and cellphone imagery to scale climate-smart crop insurance (CultiAF 109076) [Kenya] (GP/2019/177)
- 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)
- User-driven approaches to make government and farmer led smallholder irrigation in Mozambique more productive (CultiAF 109039) [Mozambique] (GP/2019/174)
- Harnessing dietary nutrients of underutilised fish and fish-based products in Uganda (CultiAF 109041) (GP/2019/176)