

# Southeast Asia

Financial year	Regional expenditure	Percentage of total bilateral expenditure	Board target as percentage of expenditure
2006-07	\$19,395,583	56.0	>45%
2005-06	\$15,885,543	51.7	>45%
2004-05	\$13,030,037	46.3	>45%

Southeast Asia is the largest of the five regions in which ACIAR conducts research activities, with eight countries involved. Indonesia is, and will remain, our largest partner, both within the region and of all partner countries. For the region an expenditure target of more than 45% of our overall annual bilateral research expenditure has been set.

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<b>Philippines</b>	<b>50</b>
<b>East Timor</b>	<b>56</b>
<b>Cambodia</b>	<b>59</b>
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<b>Thailand</b>	<b>64</b>
<b>Burma</b>	<b>66</b>



# Indonesia

Active projects in 2006–07	76
AOP budgeted expenditure in 2006–07	\$6,005,699
Actual expenditure in 2006–07	\$8,825,565
Expenditure in 2005–06	\$5,450,604
Expenditure in 2004–05	\$4,433,281

Mr John Murray, ACIAR Country Manager, Indonesia



Key performance indicators	Performance 2006–07
Information from fisheries and soil-management projects developed in response to the December 2004 tsunami disaster utilised by other users	Technical information packages in aquatic health, extension methodology, soil chemistry and pond design have been developed and transferred to extension workers, smallholder shrimp farmers, and several donor projects. Work through the WorldFish Center to help small fishers better manage the vulnerable inshore resources being continued with USAID funding. Through cooperation with the local agricultural departments the projects assisted farmers to manage soil constraints affecting rice, peanuts, soybeans and maize on tsunami-affected land.
Major agribusiness projects for the beef, fish and vegetable industries initiated	A program of project activities under the Smallholder Agribusiness Development Initiative addressing major investments in beef was designed and initiated. Several projects in other programs were commenced to underpin agribusiness development for shrimp and potato/vegetable production.
Project portfolio on avian influenza implemented and coordinated with other Australian and international donor-funded activities	Three major projects on avian influenza in ducks and poultry have commenced and complement support from other donors (especially FAO and AusAID).
Catch monitoring and assessment data systems routinely utilised for management of tuna and other fisheries of high common interest between Indonesia and Australia	The tuna longline vessel observer program was implemented to supplement the ongoing tuna port sampling system. Port sampling was established and used to update Indonesian fishery status reports.
Forty percent of new projects designed with potential for significant farmer or policymaker impacts within five years of completion	Nine of 15 full projects and four small R&D activities agreed to meet this designation.

## Position

The country's proximity and strategic importance to Australia, and the large proportion of its population in poverty but with opportunity for economic development, meant that in 2006–07 Indonesia maintained its position as ACIAR's largest partner country. Its prominence in ACIAR's program will continue. In February 2007 a series of consultation workshops were held in Jakarta to establish priorities for ACIAR–Indonesia cooperation in agriculture, forestry and fisheries for the next four years.

The regional balance of investments is influenced by Australian expertise and alignment with the Australian aid program. eastern Indonesia (including East and West Nusa Tenggara, South and South East Sulawesi) and Java and selected parts of Sumatra are equally important. In response to the December 2004 tsunami, ACIAR has commenced projects in affected communities in Aceh; some of these are in conjunction with the Australia–Indonesia Partnership. ACIAR encouraged linkages between the research agencies in agriculture, forestry and fisheries and the policy/implementation directorate-generals in the same ministries where appropriate. Likewise, ACIAR will support linkages between the research capacity in Java and eastern Indonesian and Sumatran adaptive research agencies and planning authorities.

ACIAR also emphasised Indonesia in its multilateral program, delivered in conjunction with the International Agricultural Research Centres. In Indonesia those involved are the Center for International Forestry Research (CIFOR), the World Agroforestry Centre (ICRAF), the International Potato Center (CIP) and the World Vegetable Center (AVRDC).

In 2006–07, ACIAR's Indonesia program continued to emphasise animal health and production, crop protection (integrated with horticultural crop production), forestry, fisheries and agricultural policy research,

especially in eastern Indonesia. Research collaboration included aspects of crop, livestock and fish biological security, and through policy research focused on agribusiness and the implications of decentralisation for the sustainable management and development of agricultural and land resources.

## Achievements

**Collaborative research on crop and livestock diseases** is a major emphasis of the ACIAR–Indonesia collaboration, both because of direct impacts on production but also because of the need to contain biosecurity threats.

Huanglongbing (also known as **citrus greening**) is a severe problem for growers throughout Asia. In Indonesia, scientists have confirmed that a psyllid insect transmits the causative proteobacterium from plant to plant, and they have made progress in understanding how to control greening, especially through the application of mineral oil sprays.

Rapid expansion of **cocoa production in the outer eastern provinces** of Indonesia has led to the involvement of 400,000 smallholders. Indonesia is now the world's third largest exporter of cocoa, but the industry in South and South East Sulawesi is afflicted by conditions such as cocoa pod borer, phytophthora pod rot and vascular streak dieback. A second phase of a major project, in collaboration with Indonesian industry, provincial and national government and other donors, is helping to build capability to collect, maintain and identify pest and disease resistance in different lines of cocoa, and also to determine which have the best quality characteristics. In northern Sulawesi, cloves, vanilla, sago and maize (all important domestic or export crops) suffer from what appear to be **soil-borne fungal diseases**. Progress had been made in understanding disease management strategies for vanilla stem and root rot, along with the

epidemiology of clove decline, by studying the dissemination of the fungus pathogen in the soil and the insects associated with plants affected by clove decline.

Work on disease and pest management is closely integrated with other efforts to improve crop production, quality and marketability. With other horticultural crops, major collaborative efforts are underway with bananas in West Sulawesi and Java, and chilli in Java. In another project, **potato and brassica crops** grown in rotation are under study. The Indonesian provinces of West and Central Java account for half of the total Indonesian production of both vegetables, but their yields are well below international standards, while quality of potatoes for high-value uses is variable. A project is introducing integrated crop management practices, proven in Australia and Indonesia, which will substantially lift yields. An improved seed supply system for potatoes is also helping lift productivity and quality.

With livestock biosecurity, the ongoing concern about **highly pathogenic avian influenza (HPAI) and classical swine fever** has reinforced the need for effective diagnosis, surveillance and sustainable control options. Studies are monitoring the change in the structure of the avian influenza virus to support the selection of appropriate vaccines for control programs. The role of



*Avian influenza has caused serious harm to South-East Asia's tourism and poultry industries. ACIAR research is helping to mount a strong response*

ducks in the spread of the disease is also being investigated to develop effective means of managing the disease in that species. The economic importance of the disease will be

defined to assist policymakers in resource allocation. The effectiveness of vaccination for classical swine fever is also being evaluated. This work will enhance disease-surveillance capacity through a pilot program in East Nusa Tenggara.

**Infectious bursal disease** in commercial poultry is an ongoing cause of deaths, reduced productivity and immunodeficiency. Current vaccines provide inadequate protection against the more virulent strains found in Indonesia. A vaccine derived from local isolates of the virus has been shown to provide effective immunity and is in the process of transfer to commercial partners.

**Sustainable utilisation and management of forestry resources** is a significant area of ACIAR involvement. In a project studying **community partnerships for plantation forestry**, a survey of current and potential marketing channels for sawn logs revealed a wide variety of partnership arrangements for commercial forestry, generating a mix of outcomes for growers, companies and government agencies. The project found that a high level of social cohesion in farmer forest groups was a critical requirement for improving their returns from forestry.

There is much concern about **fungal heart rots**, which threaten future establishment of acacia plantations in Indonesia. **Root rot fungi** pose another problem. A project has assessed the incidence of root and heart rots in different Indonesian environments. Australian researchers assisted collaborators in Yogyakarta in establishing DNA-sequencing methodology as a means of identifying fungal isolates.

The program strives to promote **profitable agribusiness systems for eastern Indonesia**. ACIAR implemented a **new agribusiness program** in Indonesia, in close association with the **Smallholder Agribusiness Development Initiative** (see page 40). Priorities for research investment were identified, with institutional

development and market assessments continuing throughout the year. Over 20 technical and market assessments have been designed to identify researchable issues and impact pathways with over a dozen completed. The first group of collaborative R&D projects has been designed and implemented.

One project that has been running for 4 years in eastern Indonesia is studying **better use of cassava**. This hardy root is an important crop in Indonesia, supplying food for humans and livestock, but in the past decade the country has moved from net exporter to net importer. A collaboration involving the International Center for Tropical Agriculture (CIAT) is testing high-yielding varieties of cassava for their suitability in different regions of Indonesia as well as in East Timor. Many farmers have welcomed the opportunity to trial some of the high-yielding lines on their own farms.

Other project work is helping smallholder farmers in eastern Indonesia to develop, test and apply tools and knowledge-sharing techniques to **improve Bali cattle production**. The work has involved a multidisciplinary team comprising forage, livestock, farming-systems scientists, social scientists and economists from both Indonesia and Australia. They have sourced benchmarking information from a combination of historical village records, interviews with both farmer groups and individual farmers, and the 'expert knowledge' of staff from the collaborating extension and development agencies.



*ACIAR research allows farmers better feeding options for their livestock*

All this information has been supplied at farmer workshops, giving participants access to better options for their livestock production. Efforts are underway to increase growth of weaned Bali calves. Researchers undertook feeding experiments at several study sites, and local farmers had the opportunity to visit and view the experimental activities. During the visits they were interviewed to determine their current practices and their perceptions of the experimental treatments and results. On completion of the feeding studies the team will conduct an economic analysis and also demonstrate best-bet options on-farm that will lead to optimal growth rates of the weaned calves. Cost-effective vaccines against Jembrana disease in Bali cattle are being developed with a commercial partner and in partnership with the Government of Indonesia.

ACIAR's Indonesia program has addressed **policy options for Indonesian agribusiness**.

In one project, officers in the Indonesian Ministry of Agriculture (MOA) are receiving training in detailed trade analysis of global markets. Their training has implications for Indonesian agribusiness companies, who will benefit with help from the MOA officers to analyse export markets and develop new export strategies. Longstanding joint research efforts to better understand the fishery characteristics and related resource status of commercially important shared fish stocks between Indonesia and Australia continued, with the study on sharks and rays drawing to a close. Amongst its many achievements has been the publication of a well-received illustrated guide to the commercially important shark and ray species in Indonesian waters (see page 41). Research on tuna is now in its third year, with the tuna longline fishery observer program functioning well and the country fishery status report in draft form.

In a focus on **better planning for more productive smallholder aquaculture**, a project involving the Australian Institute of

Marine Sciences and partner laboratories in Bali and South Sulawesi is studying water-quality parameters and chemical composition of the sediments in the vicinity of experimental sea cages, which are part of a lucrative industry providing income for coastal communities throughout the tropics of Asia. A parallel project with the same partner agency in South Sulawesi, the Research Institute for Coastal Aquaculture, and involving the University of New South Wales is developing simple mapping and planning tools to guide land-use decision-making regarding aquaculture developments in coastal areas, by farmers themselves, and at local and national policy levels. The geographical coverage of both projects has recently been extended to include more intensive aquaculture sites in Lampung, South Sumatra.

ACIAR has an ongoing commitment to help restore agriculture and fisheries in the regions affected by the **tsunami**. The tsunami destroyed or severely damaged more than half of the province's **brackishwater aquaculture ponds ('tambaks')**. A project to build technical capacity and support research for the reconstruction of tsunami-affected tambaks in Aceh has delivered regular technical training workshops covering soil assessment, soil remediation, pond and canal engineering, and pond management. ACIAR and the AusAID-funded Australia–Indonesia Partnership (AIP) are also cooperating on the reconstruction and rehabilitation of the Regional Brackishwater Aquaculture Development Centre at Ujung Batee, the technology development and extension centre for aquaculture in northern Sumatra that suffered extensive damage in the tsunami.

Another fisheries project, collaborating with the WorldFish Center, has undertaken a community-needs assessment and surveyed the fisheries resource status in Aceh. Evidence of **unsustainable fishing practices and overfishing** were already threatening fisheries pre-tsunami, and this

is an opportunity to introduce the concepts of long-term sustainability to coastal communities.

During the year projects also commenced to lift **productivity of tsunami-affected soils**. One project confirmed that high salinity of water in the root zone or rice bay is a widespread and persistent production problem. Timely assessments of soil salinity using methods tested in this project can prevent waste of effort and inputs by avoiding establishment of crops in areas that are still too saline, and indicate when it is appropriate to introduce specific practices to alleviate salinity. The project has trained research and extension staff in a rapid field method to assess soil salinity in relation to crop performance. Soil mapping has identified **acid sulfate soils and sandy textured soils** as the principal limiting factors for reconstruction. The mapping work in Aceh revealed that approximately 470,000 ha of coastal sediments could be classed as acid sulfate soils. Tidal conditions are also an important factor and require site-specific assessment. Soil remediation methods developed under an earlier project can be applied to the acid sulfate soil problems in Aceh, but there are no easy solutions for the sandy soils.



*ACIAR has an ongoing commitment to help restore agriculture and fisheries in the regions affected by the Boxing Day 2004 tsunami*

## Smallholder Agribusiness Development Initiative (SADI): ACIAR's role

SADI, a 10-year program with an initial funding commitment from the Australian Government of \$38 million for the July 2006 – December 2009 period, aims to improve rural-sector productivity and growth in four eastern provinces. It will improve incomes and productivity for farmers and agribusiness in response to market opportunities, through a process that is underpinned by improved adaptive R&D capacity. It comprises three subprograms, each of which also builds on existing activities in Indonesia:

- enhanced smallholder production and marketing (implemented by the Kecamatan Development Program Secretariat of the Ministry of Home Affairs, supported by the World Bank)
- strengthened private-sector agribusiness and small to medium enterprise development (implemented by the International Finance Corporation)
- support for market-driven adaptive research (implemented by ACIAR).

The purpose of the ACIAR–SADI subprogram is to develop strengthened province-based agricultural R&D capacity that is market- and client-driven and to effectively transfer knowledge to end users. A feature of this subprogram is its integration with other subprograms on enhanced smallholder production and marketing and strengthened private-sector agribusiness development.

In its first year, significant progress was made. Project offices were established in Makassar and Bogor, and international and Indonesian research and support staff appointed. Priorities for research investment were identified through workshops of industry, farmer groups,

government and researchers held in each of the four partner provinces in November 2006, and through institutional and market assessments. ACIAR–SADI is focusing on areas that build on provincial experience in a product but allow the development of profitable and sustainable supply chains. Over 20 technical and market analyses have been designed to identify researchable issues and impact pathways, and over a dozen, focusing on fruit, vegetables, estate and field crops and some aquaculture products have been completed. The first group of collaborative R&D projects has been designed and implemented.

Initial field consultation was completed for a second ACIAR–SADI component, which aims to establish improved linkages and more effective knowledge transfer processes between R&D providers and extension providers. New extension media and methods to assist in dissemination of R&D outcomes will be piloted in the field. A final component focuses on institutional development, and will assist with the development of optimal R&D planning and budget-allocation policies and procedures, assist in human resources development and upgrade infrastructure and equipment. In-depth institutional and information-technology assessments were conducted centrally and in the Assessment Institutes for Agricultural Technology in each of the four partner provinces. A number of training activities were conducted, including a 2-week study tour of Australia for senior managers. This exposed the group to current Australian best practice in research priority setting and funding, and the role of industry, farmers and inter-institutional collaboration in delivering targeted and relevant research outputs.



*Smallholder farmer grazing his cattle along the roadside*

## Surprising diversity revealed in shark and ray survey

During the past 50 years, Indonesia's extraordinary shark and ray diversity has developed into a critical commercial commodity for many millions of people throughout the archipelago. One key factor has driven the massive growth in the exploitation of sharks in this region, as it has elsewhere in the world—escalating demand from China for shark fins. Almost all species are targets and large dried fins can attract as much as US\$1,500 each in Hong Kong.

Before Australian fisheries biologist Dr William White visited Indonesia, he thought that gathering information about the sharks and rays caught by local fishermen would be a reasonably straightforward task. But in his first forays into Indonesia's fish markets he quickly realised that here was an array of species that didn't fit with current knowledge. At the time he was working on an ACIAR project, exploring artisanal shark and ray fisheries—traditional operations run along subsistence lines—in eastern Indonesia. The project recorded sharks and rays of sizes and in locations that were not expected, and found species that turned out to be new to science.

The work has grown into the most extensive biological and taxonomic investigation of Indonesian sharks and rays ever undertaken, a collaborative effort that ultimately involved

scientists from CSIRO, Murdoch University and Indonesia's Institute of Sciences and Research Centre for Capture Fisheries.

Dr White and his Indonesian colleagues trained local people in rudimentary aspects of shark and ray biology and taxonomy and, with their help, documented more than 40,000 individual sharks and rays from 14 fish landing sites and markets across Indonesia's east. Basic biological data, such as size and sex, were recorded for almost half of these.

At least 20 new shark and ray species were discovered, and in late 2006 ACIAR released a bilingual book, *Economically important sharks and rays of Indonesia*, based on the project's findings. It will radically expand global awareness of Indonesia's sharks and rays, and is seen as a critical tool for further research into commercial fish stocks of interest to Indonesia and Australia.

As well as Dr White's study, Professor Malcolm Tull from Murdoch University has led a team to gain a better understanding of the socioeconomic issues surrounding eastern Indonesia's artisanal shark and ray fisheries. The work so far has enabled Professor Tull and his colleagues to prepare advice on policy and management strategies to support more sustainable economic activity for the region's small fishermen.



At least 20 new shark and ray species have been discovered in Indonesia

# Vietnam

Active projects in 2006–07	41
AOP budgeted expenditure in 2006–07	\$3,141,101
Actual expenditure in 2006–07	\$2,912,043
Expenditure in 2005–06	\$2,818,648
Expenditure in 2004–05	\$2,983,069

Mr Geoff Morris, ACIAR Country Manager, Vietnam



## Medium-term strategy

ACIAR's Vietnam strategy emphasises research to assist the enhancement of smallholder incomes through crop and livestock diversification within farming systems, and improving market access through the improvement of the safety and quality of agricultural products. Research will examine the comparative advantage of particular commodities for domestic and export markets and options for the development of rural agricultural enterprises, including efficiencies of cooperative production and marketing. Fisheries research cooperation will focus on aquaculture, while forestry cooperation will address both conservation and utilisation, with an increased emphasis on higher-value products. Natural resource management research will focus on sustainable cultivation systems for poor soils in central and southern Vietnam and on water conservation. Close linkages to AusAID-funded programs—Collaboration for Agriculture and Rural Development (CARD) and the Quang Ngai Rural Development program—will continue to be strengthened.

Key performance indicators	Performance 2006–07
Linkages between ACIAR-funded research and AusAID-funded development continues to be maintained in at least four CARD projects	Direct linkages between ACIAR projects and seven new AusAID CARD projects were selected for commencement in 2006–07.
Surveillance and diagnostic systems and manuals developed for plant pests and diseases	A manual was developed on surveillance for plants and used in courses conducted throughout Asia. A second manual covers the collation of disease information, illustrations and training notes used in disease diagnosis from many ACIAR projects.
Adoption of fruit-fly management technology and commercialisation of protein baits in north and south Vietnam	Adoption of fruit-fly management technology by tropical fruit growers in southern Vietnam has spread to low-chill stone fruit growers in northern Vietnam. A joint venture was established to commercialise the baits.
Increased emphasis on animal health and biosecurity issues commensurate with the rising concern of avian influenza and Vietnam as an Asian epicentre	Several projects help Vietnamese farmers to manage biosecurity threats, including avian influenza, pest fruit flies, citrus greening, stored grain pests and brown planthopper and viruses in rice.

Continued emphasis in aquaculture and fisheries with new projects on shrimps and oysters initiated	A project to assist with the development of a profitable smallholder-based marine mollusc culture industry in Vietnam will start in the first quarter of 2007–08. Vietnam is also a key partner country in an ACIAR-funded NACA-mediated regional network, which will be established to promote the development and broad application of best management practices in shrimp culture through the timely sharing of experience and information.
Forty percent of new projects designed to have significant farmer or policymaker impacts within five years of completion	Four of six projects developed (two standard projects and four small R&D activities) were deemed to have these potential impacts.

## Relationship to the AusAID Vietnam strategy

AusAID's program in Vietnam has two strategic objectives. Within the first, 'Broad-based growth by strengthening the governance of the institutions required for a competitive market economy', two sub-objectives are emphasised—to improve the private-sector operating environment and to facilitate internal and international economic integration. Within the second, 'Improved livelihoods for the rural poor focusing on the Mekong Delta and the Central Coast', there is emphasis on four sub-objectives: increased rural productivity, developing human capital, reducing vulnerability to environmental and economic shocks, and strengthening the capacity and accountability of government and the participation of the poor in their governance.

ACIAR's Vietnam program complements AusAID's strategy closely, by supporting underpinning research and development interventions. Major emphases are collaborative investigation of better policy options and interventions for meeting market specifications and opportunities, and technical cooperation to improve market access through the improvement of the safety and quality of agricultural and fisheries products. Although much of the program is necessarily based in Ho Chi Minh City or Hanoi and surrounding provinces because of the location of research institutes and policymakers and the national relevance of particular projects, there is strong emphasis on central coastal regions and the Mekong Delta, with half of the projects in the portfolio working in these regions.

## Position

ACIAR's program in Vietnam commenced in 1993, and since that time a significant program in forestry, land and water resources, animal sciences, crop sciences, fisheries and postharvest technology has emerged. While training remains very important there has been an evolution from a predominant emphasis on capacity building to one of practical farmer and policy impact.

Some successes include improvements to rice–shrimp farming, integration of mangrove forestry and shrimp production, improvements to inland pond and small reservoir culture fisheries, introduction and dissemination of improved pig breeds, non-chemical rodent control in rice crops, fast-growing acacias, introduction of improved Acacia forest germplasm, better irrigation management, improved soil fertility management and better control of citrus pests. Some of the technologies arising from these projects are being applied and capacity is being developed in R&D and extension through the AusAID CARD program.

Several new projects focus on extension or adaptation of outputs from earlier ACIAR projects in Vietnam and elsewhere in the region. While most of ACIAR's program is currently based in greater Ho Chi Minh City and Hanoi because of the location of research institutes and policymakers and the national relevance of much of the portfolio, at the

February 2004 country consultation it was agreed that emphasis on central Vietnam, particularly central coastal regions, should increase.

ACIAR will also continue to seek greater involvement of the private sector and NGOs in projects, linkages with other R&D activities and donors, and development of closer linkages between Vietnamese research and extension organisations. There will also be an increased emphasis on implementation of the results of earlier ACIAR-funded research, including developing manuals and other communication materials.

### **Achievements**

During 2006–07 new project opportunities were taken up in selected areas of agricultural development policy and economic analysis, animal sciences and fisheries. As well, a number of current projects across all program areas were extended to increase the uptake of results by farmers and also incorporate them in the policy process. The program was divided into the following themes:

- increasing market competitiveness of Vietnamese agricultural and fisheries products
- optimising water and soil management for sustainable production, particularly on degraded lands.

ACIAR has contributed a sustained effort to develop better policy interventions for meeting market specifications and opportunities. A project to strengthen agricultural marketing activities in Vietnam has undertaken case studies on fruit marketing in the northern mountainous regions. These studies were later discussed at a workshop attended by Department of Agriculture and Rural Development scientists, district extensions officers, People's Committee officials, and several fruit farmers. The discussion revealed the need to give more emphasis to markets, particularly when developing policies supporting supply expansion. During the project Vietnamese

economists had the opportunity to observe and learn from a field trip to Australia. They visited ABARE, the Productivity Commission, and the Economics Division of the New South Wales Department of Primary Industries, as well as several universities. Another visit of significance was to the Sydney fish markets. The trip introduced them to some institutional design concepts that are being incorporated into Vietnam's new Institute for Policy and Strategy for Agriculture and Rural Development.

Tay Nguyen (Central Highlands) supplies agricultural and forestry produce to domestic and international markets, and the region is also the leading coffee producer. Government policies have intensified agriculture and forestry and the population has also risen in the past three decades. Groundwater consumption has now reached unsustainable levels, with droughts in 2003 reducing agricultural production and threatening domestic water supplies. A project is undertaking biophysical and socioeconomic **assessment of groundwater access**. The project team is calculating long-term water availability, conducting a social cost–benefit analysis, and then guiding the development of a cost-effective institutional framework to encourage improved water use. Data gathered from extensive surveys have enabled researchers to estimate household water demand and environmental flow values. As well, farm survey results have helped to estimate the water crop production function for dry season irrigated rice. The findings reveal substantial scope for increased irrigation efficiency in rice production, which will actually improve economic returns to rice farmers. This increase in efficiency will reduce volumetric demand for water, making more available for other uses.

**Diseases of fruits and vegetables** affect many crops in Vietnam, including coffee, pepper, watermelon, sugar, citrus and durian. Diseases, especially soil-borne fungal diseases, are a concern in the central



*New fruit-fly control techniques provide a more reliable income for fruit growers and their families in Vietnam*

provinces of Quang Nam, Quang Tri and Hue. Earlier ACIAR-supported research with the Hanoi Agricultural University (HAU) built molecular diagnostic capacity, and now a project is focusing on building capacity in diagnosis of soil-borne diseases in these three provinces. To date the research team has established diagnostic laboratories in each province and surveys are underway. So far the team has identified the pathogens causing quick wilt of black pepper, pineapple heart rot and peanut root rot. Fungal diseases identified in Quang Nam include a key disease of short and tall beans and three pathogens of chilli (a major crop). Bacterial wilt was diagnosed in a range of crops such as tomato, bitter melon and tobacco, indicating that this pathogen is of significant economic importance. An initial survey of coffee decline indicates that the problem may be a consequence of termite damage of the bark on the upper tap root and lower stem. This facilitates infection by fungal pathogens, which then develop a slowly spreading root rot. Trials are now in progress to evaluate control measures for all the identified pathogens.

Although the small **temperate fruit industry** in the northern Vietnamese uplands is the subject of much research, outcomes will be limited without improved postharvest fruit handling and effective disease controls. Up to 25% of fruit was lost and marketed produce was often small and immature. A project has focused on identifying and implementing feasible improvements. The initial strategy has been to conduct experiments in commercial orchards, prove the management techniques under Vietnamese conditions, then use the results as extension tools. As a result fruit quality has already improved in experimental orchards across three northern Vietnamese peach and plum production regions, largely through simple management techniques costing



*Vegetable market in Hanoi*

little to implement. Vietnamese project staff learn the techniques and pass them on to farmers. The addition of fertilisers, mulches, canopy management, fruit thinning and pest management has led to larger, better quality fruit and farmers are now receiving better prices for their produce.

During 2006–07 there was continued emphasis in aquaculture and fisheries. Page 49 has details of progress with reservoir aquaculture. Other projects addressed issues of culturing mud crabs, spiny lobsters, shrimp, finfish and molluscs. Results from **feeding experiments with mud crabs** in intensive culture systems at the Research Institute of Aquaculture at Nha Trang showed that the highest final weights were obtained with crabs fed a diet containing 43% crude protein and 15% lipid. Furthermore, it was shown that up to 25% of fishmeal in formulated diets could be replaced by either krill meal or soybean meal without significantly reducing growth performance. Pilot pond trials were then conducted at Nha Trang to determine if diets developed using the intensive culture systems could be applied to semi-intensive pond culture systems typically used in commercial crab culture in South-East Asia. The studies showed that growth equivalent to that achieved using trash fish can be obtained with the formulated diets. Significantly the final weights of crabs grown in pond environments were 8–10 times higher than those grown for an equivalent period in the intensive culture systems. Apparently additional natural nutrition available in pond environments promotes the higher weight gain, and the scientists are now studying how they can obtain growth equivalent performances from the intensive culture.

**Lobster aquaculture** in Vietnam relies on the collection of wild seed but they have high rates of mortality in caged grow-out facilities. An extensive study is revealing much about the ecological impact of lobster seed collection and seasonal incidence of breeding in caged lobsters. Studies are underway

to determine how to reduce post-capture losses of these seed lobsters, to develop less polluting methods for cultured lobster grow-out, and to optimise lobster feeds and feeding schedules.

Small-scale aquaculture of **freshwater species in the Mekong region** in Vietnam (and also Cambodia) is a potential important source of income for villagers. But costs associated with feed and feeding, along with limited availability of suitable feed ingredients, have limited development. A project to identify prospective feed ingredients has collected a range of samples for an ingredient database. The digestible value of eight key ingredients has been determined, providing valuable guidelines for future feeding. This project will have the added bonus of making a major impact on the catfish industry in the Mekong Delta, where there have been rapid moves away from farm-made feeds to commercially extruded diets and from river-based cages to ponds. Total production of catfish is now approximately 415,000 tonnes per year—a yearly increase of more than 100,000 tonnes since the project commenced.

A new initiative is exploring the potential for **culturing bivalve molluscs** such as native clams, mussels and oysters. A project just underway is looking at how to better utilise this resource for Vietnam, which, despite its 3,000-km coastline, trails its Asian neighbours in production. China has moved from



*Freshwater crab*

gathering natural seed to hatchery-produced seed, and this project will attempt to emulate that success in Vietnam with a guided program of training and potential species evaluation to develop bivalve hatcheries.

Smallholder farmers supply 80% of all pigs in Vietnam, but the long-term viability of production is threatened by the high cost of feeds, most of which are imported. A project is exploring the feasibility of **feeding cheaper local feedstuffs**. One possibility is meal made from rubber seed, but it contains considerable amounts of cyanide when harvested fresh. The project has developed a protocol that successfully removes virtually all the cyanide, but further testing is needed before digestibility and feeding studies of this highly nutritious product take place. Another possible source of feed is the residue left after processing cassava to remove the starch. The project team has visited a number of cassava-processing plants and believes that, once the matter of cyanide has been settled, there is potential to modify the plants

to commercially process the rubber seed. Pig-feeding studies with cassava residue have provided information on the nutritional value of this by-product and the levels at which it can be effectively and safely used.

Demand for beef products is rising in Vietnam, and cattle-rearing and finishing are considered top priorities for smallholders in Quang Ngai province. A project is helping to establish **year-round feeding options** by cataloguing available feeds and their nutritive characteristics. Two feeding experiments have provided data on liveweight gain responses to different combinations of forage and locally available concentrate supplements. Verification of feeding options has involved working with farmers in Hanh Phuoc commune. A participatory approach has given those farmers involved a sense of ownership and increased their level of commitment. Results of this study indicate improved weight gains, with the farmers agreeing that the technologies are easy to implement and profitable for them.



*The opening ceremony of a workshop on enhancing the safe production, promotion and utilisation of indigenous vegetables by women in Vietnam, from left Dr Nguyen Van Bo, His Excellency Mr Bill Tweddell, Her Excellency Madame Truong My Hoa, Mr Peter Core, Madame Ha Thi Khiet, Mr Geoff Morris, Dr Dao Xuan Hoc.*

In a related activity in Quang Nam province, an ACIAR initiative is augmenting the World Vision Vietnam Area Development Plan by **training World Vision staff and community leaders** to administer and manage projects to improve cattle productivity. Extension staff in the district and communes are gaining technical and extension knowledge, so that they can help local people to adopt the more productive technologies.

Lack of water hampers agricultural development in the coastal provinces of central Vietnam; also sandy soils near the coast are highly permeable and infertile. An ACIAR project just commenced is designed to increase farmers' incomes by improving

the productivity of horticultural crops such as cashews. It is introducing technologies that enable **efficient use of water and nutrients**—nutrient management strategies can minimise leaching losses, particularly in areas with shallow groundwater. The project is focusing on getting the most from wet–dry seasonal climates. In particular it is trialling partial root zone wetting and drying (PRD), a highly efficient irrigation technology that to date has not been evaluated in wet–dry season climates. The project is also helping to build the technical capacity of the Agricultural Science Institute for Southern Coastal Central Vietnam, which is being developed as the main research and extension centre for central coastal Vietnam.



*Marine finfish cage farm in Ha Long Bay*

## Facing the future for Vietnam's reservoir aquaculture

ACIAR has supported a suite of initiatives over the past decade, aiming to improve fish production from inland water bodies in Asia and Australia. The studies are on both larger perennial systems and smaller seasonal water bodies.

The first Vietnam project started in 1998. It highlighted several areas for potential research and led to the development of two new linked projects. One, a technical activity within the Fisheries Program, concerned culture-based and capture fisheries development and management in reservoirs in Vietnam, and focused on improving the fish yield from small-to-medium-sized farmer-managed systems as well as larger reservoirs. The other, within the Agricultural Development Policy Program, focused on the economics of developing reservoir aquaculture in Vietnam and looked at how to help local fisher and farmer communities by increasing the economic value of such fisheries.

The first project introduced local communities in northern Vietnam to knowledge-based management of cultured fisheries in small reservoirs. Outcomes included determination of best fish species combinations to grow in the reservoirs, effectiveness of staggered harvesting, and use of manures added to the water to increase yields.

The project team believes that the research results have led to attitude changes among stakeholders and more ready adoption of culture-based fisheries in reservoirs. Project members have also been instrumental in convincing Vietnamese Government institutions to recognise fisheries resources as integral to reservoir functions, leading

to development of line agencies for their management.

The project found little evidence of environmental impact of the present culture-based fisheries, which is not surprising since fish stocks are currently fed primarily on natural food with extremely low input of supplemental feed. The environmental impact of cove culture on capture fisheries in large reservoirs is less clear, because cove areas are important as feeding, nursery and spawning grounds for capture fisheries. The whole situation may change dramatically as the Vietnamese Government works towards its target of lifting current production of 20,000 tonnes to 250,000 tonnes by 2010.

The second project emphasised the economic development path for reservoir fisheries in Vietnam, viewing reservoirs as a multiple-use resource that needed managing to produce the best outcomes for all groups in society. For instance, the importance of water use for electricity generation and farm irrigation could mean that decisions taken by those in charge of them would adversely influence growth of reservoir fish production.

A key element of the project has been the development of the BRAVO model of reservoir aquaculture in Vietnam. This model, which is underpinned by biological and economic data, has provided useful insights into the potential profitability of reservoir culture and the need to strengthen institutional arrangements for reservoir leasing and credit arrangements. The 'risk' version of the BRAVO model has already developed risk profiles of reservoir aquaculture and defined the scope to improve profits and reduce income variability.

# Philippines

Active projects in 2006–07	28
AOP budgeted expenditure in 2006–07	\$2,943,835
Actual expenditure in 2006–07	\$2,832,625
Expenditure in 2005–06	\$2,829,547
Expenditure in 2004–05	\$2,295,395

Ms Cecilia Honrado,  
ACIAR Country Manager,  
Philippines



Key performance indicators	Performance 2006–07
Ongoing involvement of farmer groups and local government in participatory research and extension in ACIAR projects	Participatory research and extension is a feature of three projects commenced in 2006–07.
Priorities from 2006 Philippines–ACIAR country consultation addressed in development of new themes and projects	Several projects under design address improved quality and marketing and market access for vegetables. In fisheries, two new projects investigate the potential for reef ranching and restocking of sea cucumbers, and opportunities to improve product quality, market access and prices for molluscs. A major scoping study on policy constraints to the adoption of research outputs was conducted.
Community Agricultural Technologies Program (CATP) commenced and at least six new collaborations between Philippine—ACIAR researchers and NGOs formed	CATP commenced and six collaborations with NGOs were formed.
ACIAR–AusAID Landcare project farmer groups established in Agusan del Sur and Bohol, implementing livelihoods diversification approaches	Two new Landcare sites in Agusan del Sur and Bohol have been established. Livelihood diversification approaches have been successful.
Forty percent of new projects to have significant farmer or policymaker impacts within five years of completion	One of two ‘standard’ projects developed in 2006–07 were specifically designed to have ‘Category 1 impact’. In addition seven CATP projects were implemented.

## Position

ACIAR’s program in the Philippines has been active since 1983. Initially the program had several projects dedicated to research on soil management issues—nutrient management, erosion control, rice cropping systems, biological nitrogen fixation and tree establishment on degraded land. Research on postharvest storage of grain and giant clam culture was also important. During the

1990s research cooperation shifted towards livestock management and biotechnology. A shift in project location, to emphasise the poorer areas of Mindanao and the Visayas but maintaining strong links to research and development expertise in Manila and Los Baños, will continue.

Improving uptake of research in the Philippines is a major priority and, in

## Relationship to the AusAID Philippines strategy

The AusAID Philippines country strategy has three key objectives: to remove impediments to broad-based growth through stronger economic governance; to improve security and stability through counter-terrorism capacity building, support for the Mindanao peace process, and humanitarian and emergency assistance; and to improve the living standards of the rural poor in the southern Philippines. AusAID assistance to raise rural incomes includes programs to improve local government planning and service delivery, rural production and marketing, and basic health and education services as well as vocational and technical training.

collaboration with Philippines partners, ACIAR has increased its emphasis on better understanding extension processes and involving farmer and community groups in projects. In recent times there has been encouraging success with the adaptation of the Landcare approach in Mindanao, management of catchments in the Visayas island of Bohol, and in the uptake of methods for successful tree establishment on degraded lands. New research projects should be underpinned by design processes that involve the end users of the research and address their needs. Project design should also accommodate the additional challenges that have arisen from the devolution of the management and governance of extension responsibilities to local government units, and the comparatively weak research–extension linkages that often currently exist.

With the main aim of ACIAR cooperation being to assist the Philippines to increase the marketability, international competitiveness and market access for Philippine agricultural products, ACIAR and AusAID have initiated some jointly funded activities in the areas of postharvest technology, disinfestation and pest management in fruits such as mango, and in scaling-out of the Landcare approach to farmer-driven natural resource management. During 2006 a new initiative—Community Agricultural Technologies Program (CATP)—to link ACIAR-generated technologies and Philippines research providers with non-government and community-based organisations, commenced.

One major international agricultural research organisation, the International Rice Research Institute (IRRI), is headquartered in Los Baños. ACIAR provides core funding to IRRI and also supports additional initiatives aimed at maintaining rice productivity. The regional office of the International Network for the Improvement of Banana and Plantain (INIBAP), a network of the International Plant Genetic Resources Institute (IPGRI), is also headquartered in the Philippines.

### Achievements

ACIAR's Philippines program in 2006–07 focused on three major themes:

- increasing the market competitiveness of Philippines agricultural products
- farmer-based land and water resource management for profitable and sustainable agriculture
- addressing regulatory, policy and technical constraints to the adoption of research outputs.

In the Philippines field infestations of insects cause losses and damage levels ranging from 10–40%. Insect damage may limit market access, particularly for small-scale farmers. A project has focused on how to improve **control and detection of seed and pulp weevils in mangoes**. For the province of Palawan, scientists have developed an integrated pest management work plan, designed to reduce usage of insecticides by 40% while improving control of pulp weevil, leafhoppers and fruit fly. As well, **deficiencies in the supply chain of mangoes** from producer to point of sale severely affect



*Tropical fruit stall in the markets in Davao City, Southern Philippines*

fruit quality and market opportunities. The project is developing a 'road map' from which technical or business priorities can be identified and strategies implemented to bring about improvements. So far the researchers have mapped the Philippine mango supply chain in detail, and this is now being validated during field visits to the production areas in Davao del Norte, Davao del Sur and Guimaras provinces. From the same studies the researchers are gaining an overview of the major technical postharvest problems.

A project to **introduce biofumigation** has achieved its objectives. The researchers successfully tested natural fumigants produced from residues of certain varieties of brassica crops, as a substitute for methyl bromide fumigation to combat soil pathogens, including bacterial wilt (BW) and root knot nematode. They developed a rapid, efficient screening assay to quantify volatile suppression of BW and other soil-borne pathogens. The Northern Mindanao Agricultural Research Center is making its distribution of clean potato seed to farmers in Mindanao contingent on their agreement to adopt biofumigation techniques on their

farms. Now farmers from the provinces of Benguet, Pangasinan, Bukidnon, Davao del Sur and South Cotabato have started to use biofumigation within their cropping systems and have obtained around 20% increase in crop yield. Two collaborating farmers who had abandoned potato growing on their farms have returned to the crop since incorporating biofumigation as part of their BW control strategy. They are now demonstrating the concept to other farmers in the region.

Shrinking water availability and the increasing trend to direct seeding is allowing weeds to compete during rice crop establishment. Herbicide use is rising as a result, and with it comes the potential for resistance—there are two or three rice seasons in the Philippines and hence, farmers spray herbicides up to six times per year. A project is developing a framework for examining public policy towards herbicide use and preparing to deal with actual or impending resistance. The project has established a herbicide-resistance testing procedure through PhilRice and, via a field survey and a national network of extension and agronomy agents, has screened a number of populations of major

weeds for resistance to important herbicides. Participatory on-farm trials over several seasons at four Philippines' sites have tested an **integrated weed management (IWM)** strategy combining good land preparation, intermittent water management, and single herbicide application of a pre- or early post-emergence herbicide. The IWM strategies, tested alongside the farmers' current weed management practice, are showing better weed control, increased yields and higher profits.

ACIAR has been involved for some years in programs to **introduce Landcare principles** in parts of Mindanao. Now further research has assessed the sustainability of the approach at the original sites and tested the approach at new sites with differing needs, such as on Bohol Island. Preliminary findings highlight some key factors in institutional success—commitment, competence, leadership, incentives and effective partnerships. Progress has continued in sustaining and scaling up adoption of conservation farming systems and diversified livelihoods. The latest project has facilitated or provided 55 major training and networking events, including training and exposure to expertise in nursery management, and production of many products such as forage, high-value vegetables, fruit trees, livestock, coffee, coconut, abaca, bamboo, mushrooms, medicinal plants, bananas, wood products and fish. Groups have received training in subjects such as integrated crop production, soil and water conservation, agroforestry, permaculture, soil testing, integrated pest management and biodynamic production.

A project is determining what factors make seasonal forecasting more valued. Farmers and industry people need reliable **seasonal climate forecasts (SCFs)** to better cope with the adverse effects of seasonal climatic variabilities like El Niño and La Niña. These forecasts are made prior to the start of any season of agricultural significance. By using sea surface temperatures and atmospheric

indices, a probabilistic forecast can be made. Farmer acceptance of their value relies on the ease of use, including lead time, consistency and transparency. Case studies from both the Philippines and Australia are being subjected to this value-testing via an economically derived framework. The researchers aim to help farmers in rainfed agriculture in both countries to benefit by addressing their reservations surrounding forecasting accuracy.

Smallholder agroforestry systems in Leyte are being tested for **measures to improve timber yield and quality** and to improve market access. The project team has worked to define and implement local-level policy changes in relation to tree cutting and transport regulations, with increasing success. The pressing issue of limited higher quality seedling supply has emerged as a major constraint to development of the Philippines agroforestry sector, and a newly commissioned ACIAR project will investigate how to enhance tree seedling supply via economic and policy changes in the nursery sector.



*Experimenting with protected cropping structures to reduce rainfall damage in vegetables in Leyte, Philippines*

Work on **sustainable use of shallow groundwater** has focused on two pilot sites within neighbouring municipalities in the province of Ilocos Norte, located on the north-western tip of Luzon. The project team focused on characterisation of the groundwater resources at the two locations. Data collected is helping determine sustainable yield and set up a groundwater model. The model will enable future impacts of groundwater extraction to be determined, as well as impacts of changed management. Pumping tests have determined rates of water movement through the aquifer, and pressure loggers in a number of wells have recorded fluctuations of water levels. The researchers conducted an economic assessment of agricultural productivity within the two field sites, where rice is grown during the wet season and garlic supplemented by groundwater grown during the dry season. Results showed labour and fertiliser were the largest input costs for both rice and garlic production, although the cost of fuel for water pumps is significant for garlic. Growing one hectare of garlic generates three to four times the return of rice, but rice remains a traditional crop for two reasons—it provides a staple food for household consumption and also rice straw as mulching material for garlic.

The Philippines and Indonesia are concerned about the impacts of **illegal, unreported and unregulated (IUU)** fishing, which leads to combined losses of more than US\$3 billion per annum to their respective economies. A project was commissioned following the recommendations of an earlier small ACIAR project to further research options to combat IUU in both the Philippines and Indonesia and to implement the FAO-endorsed International Plan of Action on IUU Fishing. First, national workshops on IUU fishing were held in Indonesia and the Philippines, to clarify some of the issues that the two countries must deal in addressing IUU fishing. This was followed by a bilateral workshop to assess the IUU problems in the Sulawesi Sea between the two countries. Both countries shared information on national fisheries laws and regulations, licensing systems, monitoring, control and surveillance, and data collection systems. They also discussed status of stocks and IUU fishing issues in the Sulawesi Sea, arriving at a framework for cooperation to address IUU fishing in these mutually shared waters.



*Women working in the field in the Philippines*

## Rural women take charge

Throughout Asia the story is familiar. Economic pressures are pushing members of farm households to seek off-farm work. And it is usually the wife left behind to look after the farm. Thus women are changing roles from unpaid family workers to farm managers.

Mrs Lien's husband works in a private shoe factory in Ho Chi Minh City. This leaves Mrs Lien to raise the family while she single-handedly oversees the small farm's rice-growing. She describes her life since she started running the family's irrigated farm in South Vietnam:

*My husband comes home once a year... so aside from the traditional tasks I used to do, I now have to do his jobs, such as preparing the nursery for rice seedlings, irrigating the fields, broadcasting fertiliser and spraying pesticides. After going to the market and finishing household chores, I visit our fields every day.*

In the northern Philippines, another woman whose husband is a seasonal migrant says:

*If my husband is away, I supervise the farm's crop operations. My husband leaves after the land preparation to work as a carpenter in another province for at least four months. Now I have to check when the crop is ready and start hiring labourers to harvest it. I find it difficult to hire labourers because there is competition during these peak months.*

Stories from north-eastern Thailand are similar. The women left behind must take on new managerial responsibilities. One Thai wife says:

*Although my husband's remittances from construction work are a big help to us, particularly for our children's education, I have to manage the labourers for rice production and for crop care of the rubber plantation. I make all the decisions about farm and household matters. When in doubt, I phone my husband.*

These changing roles are bringing to light another difficulty, which was outlined by Dr Thelma Paris, a social scientist with IRRI. She said:

*The women's lack of access to the information and resources they need for new crop and water management technologies can have a negative impact on the productivity and sustainability of local agriculture. Agricultural technologies, practices, policies and systems are based on the conventional assumption that farmers in developing countries are full-time male farmers.'*

Dr Paris is leading an ACIAR project that is looking at social changes occurring in agriculture in Asia and also Australia, and the changing roles of women as a result of off-farm employment or migration. The project involves IRRI, Curtin University of Technology (Western Australia), Khon Kaen University (Thailand) and the Cuu Long Delta Rice Research Institute (Vietnam). The team brings a mix of social science skills, including gender specialisation, agricultural economics, sociology and extension. She said:

*Our research should provide early warning of rapid changes that may be undermining the national and regional food security that we've worked so hard to achieve over the past several decades.*

The researchers have conducted focus group discussions with women farmers in the Philippines, Thailand, Vietnam and Australia, to identify the factors that constrain or support the adoption and diffusion of technologies and to understand more of the difficulties faced by women in agriculture due to male out-migration. As part of the project, 60 women who are heads of farms in selected villages from the Philippines, Thailand and Vietnam have an opportunity to test new strategies and improve their farm productivity. Their findings should prove valuable for women throughout the region.

## East Timor

Active projects in 2006–07	5
AOP budgeted expenditure in 2006–07	\$1,863,500
Actual expenditure in 2006–07	\$1,547,163
Expenditure in 2005–06	\$1,870,139
Expenditure in 2004–05	\$522,340

Key performance indicators	Performance 2006–07
Successful implementation of jointly funded ACIAR–AusAID Seeds of Life 2 program in close partnership with Ministry of Agriculture, Forestry and Fisheries (MAFF)	<i>Seeds of Life 2</i> is well implemented within MAFF. New varieties of maize, sweet potato, rice and peanut were released. During 2006–07, <i>Seeds of Life 2</i> installed 985 on-farm variety tests. Other activities with MAFF include training, social science and economics studies of farm households, research station infrastructure development, and seed production.
At least four demand-driven small projects commissioned to leading agricultural researchers	Civil disturbances delayed project implementation—two projects commenced with several more to commence by the end of 2007.

### Position

Agriculture provides livelihoods for more than 80% of East Timorese. The similarities of East Timorese and northern Australian environments offer Australia a comparative advantage in applying its research, development and extension skills to assist this new country. ACIAR began collaboration with East Timorese institutions in 2000, and current projects aim to help achieve food security, reduce poverty and build local agricultural research capacity. Two ACIAR projects commenced in early 2001:

- the *Seeds of Life* project, which aimed to improved crop production through introduction, testing and distribution of planting material of major staple crops that was better adapted to Timorese conditions
- rehabilitation of the agriculture faculty at the National University of East Timor.

The first phase of the *Seeds of Life* project has now concluded. A number of improved varieties of staple food crops have been identified in field trials in a variety of lowland and highland settings around East Timor.

Suitable varieties of sweet potato, maize, rice, peanut and cassava have been identified. Many of these have been tested or are in the process of being tested in farmer participatory research. Some varieties appear well adapted to local conditions, have tolerance or resistance to pests and diseases, and have demonstrated a sufficient level of tolerance to drought and soil stresses.

A major successor program, *Seeds of Life 2*, is being co-funded by AusAID and ACIAR and delivered in close partnership with the Ministry of Agriculture, Forestry and Fisheries (MAFF). The program, which has a budget of almost \$8 million over 5 years, commenced in late 2005 and is expected to continue the introduction and evaluation of improved crop varieties, while devoting more resources to seed production, the identification of improved crop management techniques, farmer participatory extension of identified cropping improvements, and to the training of MAFF and other staff in seed production as well as crop research and extension. Five international CGIAR centres will continue to supply crop materials and expertise, while NGOs will be involved in the extension where

possible. By the project's end, it is expected that many East Timorese farmers will have adopted improved varieties and cropping technologies, and that MAFF will be able to manage field crop research and development activities with its own resources.

Rehabilitation of the Agriculture Faculty at the National University of East Timor has been important in providing facilities for applied agricultural research, and in training East Timorese in agriculture. The project team has developed a new agriculture curriculum that aims to equip students to identify and solve problems in a farming systems context. Laboratory facilities at the Hera Field Station have been restored to provide practical sessions for science and agriculture students. This facility is the only working agricultural laboratory in East Timor, and a number of foreign donors are also using the laboratory in their project activities.

New projects on Siam weed control and cassava production commenced in 2004–05 and, in early 2006, a small R&D projects funding and management facility was established to support focused activities addressing high priorities in agriculture.

## Achievements

The East Timor program continued to emphasise applied research, together with the **development of local capacity** for applied research and development to underpin the reduction of food insecurity. In 2004 the World Food Programme estimated that 90% of all East Timorese households experience food shortages each year.

Through the initial *Seeds of Life* (SOL) project superior varieties of maize, cassava, sweet potato and irrigated rice were trialled. This project also established, within MAFF, a small scientific and extension base for cropping. Now the SOL2 project, undertaken in conjunction with AusAID and implemented as a program in MAFF, is building on the earlier work.

All five CGIAR centres collaborating with SOL have provided **well-adapted breeding lines and varieties** of maize, cassava, sweet potato, rice, peanut and pigeon pea for evaluation, and 23 replicated trials were installed in the main season. Select maize varieties demonstrated yield advantages in excess of 100% over locals. In the sweet potato trials, four introduced sweet potato clones all possessed yield advantages in excess of 130% over the local varieties, and were also good eating. Although the top five cassava clones have out-yielded local varieties by 40–60%, local farmers cultivating cassava desire

## Relationship to the AusAID East Timor strategy

The overarching goal of AusAID's future development cooperation program will be to assist the Government of East Timor to achieve stability and prosperity. Support over the medium term is expected to focus on **governance**—capacity building through enhancing stability and security, and improvement of public-sector management to deliver services and **basic service delivery**, including further support for rural water supply and sanitation, food security, and health.

ACIAR's program in East Timor focuses on the food-security aspect of this strategy, with AusAID co-funding the largest project in the portfolio (Seeds of Life 2), and several other projects addressing other aspects of food security. Long-term engagement of the relevant government ministry (MAFF) and the University of Timor Loro Sa'e contributes to the governance objective, particularly in terms of capacity building to deliver tertiary education and agricultural extension and research service delivery.

sweetness over yield. Thus newly introduced **varieties with high sweetness** are now being further evaluated. An additional ACIAR project, managed through the International Center for Tropical Agriculture (CIAT), is focusing on the adoption of cassava, using the tubers as food and also roots and leaves as fodder for pigs.

From earlier trials farmers have selected a **favourite line of rice** for its consistent yields and good taste. Seeds of this variety are to be released for commercial multiplication in 2007. Farmers have also expressed a desire to grow PT5 line as their preferred peanut because of its large seeds and superior yields. This variety was included in on-farm trials and is being released in 2007.

Field work has a high priority, and training is underway to teach members of the MAFF Research Development Units to direct **on-farm demonstrations and trials**. Aids in their training include fact sheets on sweet potato, maize and peanuts, and a draft farmer participation research (FPR) manual. AusAID and ACIAR together have fielded an independent Technical Assessment Group (TAG) to provide advice to the SOL program on an annual basis. TAG comprises two externally sourced consultants, with expertise in agricultural research participatory agricultural extension and institutional strengthening, and representatives from

AusAID and ACIAR. TAG visited the project area prior to preparation of the Annual Operating Plan to review the progress of SOL in the preceding year. There were also other visits by TAG as required, to evaluate the outcomes and impacts of the program.

Boosting both production and capacity of the agricultural sector in East Timor has proven difficult and will progress best on a small scale. A project is attempting this by investing in microprojects, valued between \$10,000 and \$35,000, that link Timorese researchers with local agricultural producers. Australian experts are acting as mentors and providing R&D knowledge and other information to support project development and implementation. So far **three microprojects have been approved**. They are: MP1, Analysis of farming systems in 13 districts; MP2, Scoping the current and future market for beef; MP3, Alley cropping as an alternative to slash-and-burn. Data collection is well advanced in the case of MP1 and MP2. In the case of MP3 a preliminary survey is underway to assess potential sites with stands of leucaena or other alley cropping species that have been established for 5, 10, 20 and 30 years, are representative of significant agro-ecosystems and are available for conducting soil-fertility studies.



*Mrs Janette Howard visits the Seeds of Life project in Timor-Leste*

# Cambodia

Active projects in 2006–07	17
AOP budgeted expenditure in 2006–07	\$1,513,016
Actual expenditure in 2006–07	\$1,744,985
Expenditure in 2005–06	\$1,435,960
Expenditure in 2004–05	\$1,212,879

Ms Chiraporn Sunpakit,  
ACIAR Country Manager,  
Cambodia



Key performance indicators	Performance 2006–07
Linkages maintained and expanded between Cambodian research and extension organisations in ACIAR projects	Two major projects conduct most research on farmers' fields and formally include extension personnel and provincial staff along with researchers. This linkage is also a key criterion for the Cambodian Agricultural Research Fund (CARF) projects.
Cambodian Journal of Agriculture issues published with reports of successful ACIAR-funded research	Two issues were funded and published, with several articles based on ACIAR-funded research work.
New animal health and livestock biosecurity program developed and implemented	A project was implemented to investigate innovative ways to manage and monitor livestock movements and the diseases they carry.
Project activities to enhance beef production designed and commenced	A study to define and test best practice cattle health and husbandry has been developed and implemented, while the full design of a project focusing on forages for beef production will be completed in the first quarter of 2007–08.
Disease management strategies for tomatoes assessed in the field	Tomato varieties were assessed in the field on a range of agronomic and postharvest characteristics including pre- and postharvest diseases.
Two Cambodian scientists trained in identification and management of rice diseases	Two scientists were trained and a well-equipped laboratory was established to underpin capacities in plant pathology.
Forty percent of new projects designed to have significant farmer or policymaker impacts within five years of completion	All four new projects were deemed as having most impacts after five years, although in each case some activities will impact in a shorter time frame.

## Position

Australia took a major role in assisting Cambodia on its path to democracy in the early 1990s, and in doing so pledged to provide significant development assistance over the medium term. A major component of the AusAID assistance in Cambodia continues to be in agriculture and rural development, and ACIAR will endeavour to link its research

projects to new AusAID programs. Several other donor programs in Cambodia have an agricultural and rural development focus, and where possible linkages with these programs will be established.

Cambodia has a very low per capita GDP and the predominance of rice-based farming systems on infertile soils means

## Relationship to the AusAID Cambodia strategy

The Australia–Cambodia Development Cooperation strategy emphasises poverty reduction and sustainable development in Cambodia, through three objectives: increasing productivity and incomes of the rural poor; reducing vulnerability of the poor; and strengthening the rule of law.

The ACIAR program through its two emphases (underpinning agricultural diversification, and supporting research that aims to increase the productivity of rice-based farming systems) directly supports the four thrusts of the first objective of AusAID’s program, namely improved farming techniques, product processing, access to market information and addressing market policy constraints.

that Cambodia has rather low agricultural productivity on both a labour and land-area basis. The suite of current, proposed and completed projects is targeted at research to improve rice productivity, assessing land suitability for a second rice crop, and developing options for the production and marketing of non-rice crops. ACIAR will continue to support selected initiatives in animal health and production as well as fisheries. Considerable progress has been made in developing the scientific expertise of a number of Australian-trained Cambodian researchers who should be able to contribute significantly to the development of Cambodian agriculture. ACIAR will also maintain an emphasis on short-course training in areas such as R&D priority setting and management, enhancing research-extension linkages, scientific proposal and report writing in English, and in experimental design and analysis. This will also include training and technical assistance with the production of the *Cambodian Journal of Agriculture*.

## Achievements

The Cambodia program has focused on field crop improvement and management, horticulture, land and water resources, animal health, and agricultural systems economics and management. Projects are grouped under the following themes:

- securing productivity of rice-based farming systems
- income generation and better nutrition through agricultural diversification.

Cambodia is moving away from growing largely rice as its core cereal crop and diversifying into secondary crops, to improve human and animal nutrition and boost the cash economy. Work at the Cambodian Agricultural Research and Development Institute (CARDI) now focuses strongly on **non-rice crops for the uplands**, and an ACIAR project is providing researchers, extension workers and farmers with training and experience in relation to such crops. A series of workshops conducted early in the project has helped to identify the constraints to the adoption of diversified farming systems. Farmer meetings and workshops led on to a program of field research, where farmers, provincial agricultural technicians and extensionists plus researchers from CARDI worked in collaboration to set up trials in the farmers’ fields. Between 2004 and 2006 the program undertook around 150 on-farm experiments and demonstrations, comprising studies of plant variety, insect pests and disease, reduced tillage, agronomy and farming systems. The project team has prepared manuals for growing soybean, maize, mungbean, peanut, cowpea and sesame, and drafted guidelines to help identify weed and insect pests of upland crops. Farmers have learnt the techniques to boost production by lifting the nitrogen content of the soil.

An ‘action research’ project is aiming to bring about positive socioeconomic change in the Cambodian **maize and soybean marketing** systems. A significant achievement has been the development of a successful

soybean marketing association in eastern Cambodia. The project team worked with the Ta Ong Soybean Association (TSA) in Kampong Cham province. At the outset TSA was a non-functioning association with only 14 members; it now has 160 members (with membership capped at this level). It is operating successfully as a microfinance institution, having made low-interest loans to about 1,000 farmers, and is now looking to build its own dryer-silo and market its members' produce in Vietnam.

Several diseases—brown spot, rice blast, false smut, bakanae and kernel smut—are commonly found in Cambodian rice crops, but little is known about the distribution, prevalence or impacts of these diseases. A project is training Cambodian researchers in **basic plant pathology techniques**. Surveys of lowland rice crops were carried out in five provinces in August 2006 and February 2007. The results highlighted the importance of laboratory isolations to confirm diagnoses—in many instances diseased tissue did not yield the pathogen tentatively identified on the basis of symptoms. CARDI now houses the first plant-disease herbarium in Cambodia. This will curate specimens of correctly identified diseases (initially of rice, but other crops will be included in future) as a record of their occurrence and as training material for plant-pathology personnel.

Vegetable production in Cambodia remains low, due largely to unreliable supply of seed, high input costs and a lack of knowledge of postharvest handling. A project designed to improve **vegetable production and postharvest management** has focused initially on tomato and chilli varieties. Tomato lines selected for trial came from AVRDC (the World Vegetable Center) and previously untested hybrids that commercial seed companies donated to the project. These were performance-tested against existing grower varieties. The trial sites varied in soil type and management system, and therefore the results gave a good indication

of suitability of the entries. A tomato-grower survey of 50 farmers complemented an earlier Asian Development Bank (ADB) survey of market agents, collectors and transporters. Types of information gathered about the chain of sale included the means of selling tomatoes (for instance through street vendors or wet markets), methods of packaging and handling, and levels of spoilage. A chilli survey is scheduled for the near future.

A collaborative study involving Cambodian and Lao veterinary services working with Australian partners has learnt much about what drives the movement of **domestic and transboundary livestock**. The scientists are using this knowledge to prevent the spread of livestock diseases, especially foot-and-mouth disease and classical swine fever. They now have a mechanism to explain the existing movement patterns of livestock in Cambodia, Lao PDR and surrounding countries, and have used this to compile a list of indicators that will allow timely interventions to minimise the risk of disease spread. ACIAR has recognised the significance of this work for the region by commissioning a thorough review of livestock health and vaccine development as a prelude to developing several new animal health projects.

In a project to control fasciolosis (tropical liver fluke infection) in cattle and buffalo, the project team surveyed farmers at the project site and found that farmers who received education and extension on fasciolosis and control measures had retained a greatly enhanced knowledge and understanding. Farmers were convinced of the economic impacts of fasciolosis as they realised that infected cattle demonstrated negative traits such as slower weight gain, lower fertility among reproductive females and weaker draft ability. They are keen to have the work extended.

# Lao PDR

Ms Chiraporn Sunpakit,  
ACIAR Country Manager, Lao PDR



Active projects in 2006–07	22
AOP budgeted expenditure in 2006–07	\$1,079,788
Actual expenditure in 2006–07	\$1,066,463
Expenditure in 2005–06	\$770,466
Expenditure in 2004–05	\$824,152

Key performance indicators	Performance 2006–07
Through consultation with Lao PDR partners, a new strategy for animal health and livestock biosecurity developed and implemented	A project has been implemented in collaboration with regional disease-control initiatives.
Small grants scheme for Lao research institutions implemented and engages returned overseas-trained Lao scientists	This scheme has been implemented as a new ACIAR project following a successful pilot during the previous year.
Improvements in productivity of rice-based farming systems in central Lao PDR reduce seasonal food insecurity	World Vision distributed seed of higher yielding rice varieties, which alleviated food insecurity in several districts. Farmers also increased plantings of vegetables.

## Position

ACIAR has had a program in Lao PDR since 1992, coinciding with the period of expansion of Australia's aid program to the Mekong countries. Distinguishing features of this landlocked country are low population density, high ethnic diversity, poor infrastructure, and geographical dispersion of people. Agriculture employs over 80% of the population and forms 53% of GDP. A major emphasis of past ACIAR work has been the establishment in Vientiane of an animal-diseases laboratory to service Lao PDR. Other successes include the introduction and selection of cold- and drought-tolerant rice varieties, identification of the major rodent pests affecting rice farming, capacity building in forestry research and agricultural extension approaches, management of indigenous fisheries, and provision of training, including in scientific data analysis and scientific writing in English. ACIAR has recently supported a small grants scheme to enable Lao researchers to develop skills in the design and management of agricultural research projects. In 2006–07, a number of new projects commenced. ACIAR expanded its Lao PDR program where opportunities for research collaboration with a high likelihood of farmer impact exist.

## Achievements

ACIAR's program in Lao PDR has focused on areas of animal health, forestry, fisheries and crop improvement, together with management to encourage and sustain crop diversification and reduce impacts of shifting cultivation. Projects are grouped under the following themes:

- alternatives to shifting cultivation in upland regions
- agricultural diversification to improve productivity of lowland farming.

Many of the animal health and cropping initiatives studied in Lao PDR are part of collaborative undertakings with other Mekong countries. ACIAR is investing in a range of studies to determine the best way forward for **animal health research**. One project is supporting the development of best practice cattle and buffalo health and husbandry systems for Cambodia and Lao PDR. Prior to developing a full project, ACIAR funded a small research undertaking to confirm that the key concepts and research issues, including economic drivers for enhancing large ruminant productivity, were captured. This has been helpful in defining the best avenues for ACIAR to develop its suite of

current projects and tailor the work for each country. It has also helped to identify the key partners, personnel and preferred locations for undertaking the research. Several new research initiatives have arisen as a result.

Australia and Lao PDR have cooperated since 2003 to strengthen **disease-control options for pigs** in a village setting. Of particular concern are foot-and-mouth disease (FMD) and classical swine fever (CSF). The project team has placed particular emphasis on understanding the social conditions that promote transmission of the diseases. Team members have succeeded in establishing good communication between scientists, veterinary village workers and national institutions. Information such as how piglets are traded at village markets is valuable because here is a perfect opportunity for a disease to spread. The wealth of information gathered should help to break the disease cycle. Since pig farmers in Lao PDR are mostly women, the Lao Women's Union is playing a critical role in circulating information through their extensive network.

In the northern mountainous regions rearing pigs is a widespread smallholder livelihood activity, but productivity is low due to poor nutrition. A project is seeking to **introduce forage legumes** into the farming system, to improve pig nutrition and also to reduce the time that women spend gathering and preparing feed.

Lao (and Cambodian) agriculture relies heavily on rice production from rainfed lowlands where drought is a frequent occurrence and is the major production constraint. A project has sought to **incorporate drought tolerance** into the country's rice-breeding program and thus develop varieties more resilient to drought. The project was successful in developing a method for reliable and routine screening of relatively large numbers of lines for drought tolerance. It has crossed the best drought-tolerant lines with lines for high-quality and high-potential yields, generating new lines that are resilient to drought and yet yield well in good years and have characters desired by the farmers.

Lao PDR has a small teak plantation estate but the country is expanding its resource of teak smallholdings. Optimally designed and managed agroforestry systems can provide significant income streams to rural Lao families. These plantings have become very popular and good prices are now being paid to farmers. An ACIAR project has provided information on the economic, social and other factors influencing the production and marketing of non-timber forest products and plantation teak in Lao PDR. The study has outlined the prospects for the agroforestry systems, estimated potential economic benefits, and identified major constraints.

## Relationship to the AusAID Lao PDR strategy

The AusAID program in Lao PDR aims to assist Lao PDR to improve the pre-conditions for poverty reduction and sustainable development. It supports 'appropriate recipient government development priorities as well as donor coordination and harmonisation efforts, in order to maximise development impacts...'. Sectorally the country strategy focuses on building Lao human capital by improving access to education; promoting the growth of the market economy by expanding access to private land titles and strengthening property rights; and reducing the vulnerability of the poor by reducing the impact of natural disasters and unexploded ordnance.

While the ACIAR program, in focusing on agriculture and forestry, differs in its sectoral emphasis, its overall purpose (poverty reduction and sustainable development) and strategic approach is similar. There is also a strong emphasis on assisting the Lao Government's own development priorities in agricultural research for development, and there is a particular effort in Lao PDR to harmonise with other donor programs through supporting underpinning research. Interventions in horticulture, livestock, forestry and agroforestry specifically target the market economy, and the program has a strong emphasis on capacity development training in agricultural research and extension.

# Thailand

Active projects in 2006–07	16
AOP budgeted expenditure in 2006–07	\$238,237
Actual expenditure in 2006–07	\$440,157
Expenditure in 2005–06	\$501,180
Expenditure in 2004–05	\$522,291

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ACIAR Country Manager,  
Thailand*



Key performance indicators	Performance 2006–07
All new projects under development are focusing on implementation of results of earlier ACIAR projects	A Fisheries project commenced to complement the results of an earlier project on shrimp-virus testing including field validation. Thai involvement in the Lao rice-based systems project builds on earlier ACIAR work in Thailand.
NGOs and farmer groups continuing to build upon ACIAR-funded pilot projects using their own resources	World Vision is expanding 'clean vegetable production' to at least four other provinces. Communities are also scaling out work on low-cost fish-feed production using their own resources.

## Position

Thailand was an early and large collaborator, with many projects successfully undertaken. However, as Thailand's own economic and research capacity has increased, its involvement in ACIAR projects has diminished. Successful outcomes include techniques to ensure longer shelf life that have enabled the expansion of tropical fruit exports, the development of cooler climate fruits for the hilly regions of northern Thailand, and fruit-fly identification and control. New fish feed made from cheap, locally available ingredients has helped thousands of Thai fish farmers. A substantial investment in diagnosis and control of foot-and-mouth disease has made Thailand the accepted regional centre of expertise in South-East Asia. The use of software (developed under ACIAR support) to assist in selection in cattle-breeding programs has been recognised through national awards. Over 10,000 hectares of suitable fast-growing Australian trees are planted each year as a result of ACIAR research.

It is expected that Australian investment in projects will continue to decrease in line

with the increasing ability of Thai partners to co-invest in projects of strong mutual importance. In some cases, there are spillovers to less developed countries from drawing on the development experiences of Thailand. ACIAR's project investment will be very highly selective and will focus only on implementation of the results of earlier ACIAR projects.

## Achievements

The program with Thailand continues to capitalise on the benefits arising from technical and policy research to underpin trade of agricultural products. It emphasises the importance of policy research and market chain incentives in underpinning agricultural developments. Opportunities to promote the application of technology, using both conventional extension methodologies and new approaches, are sought for the benefit of farmers in upland northern Thailand and north-eastern Thailand.

A project to extend earlier work in Thailand with **low-chill fruits** has tested a wide range of species (plum, peach, nectarine, pear and persimmon) in Thailand, and varieties are

now being tested in Vietnam and Lao PDR to replace poor-quality, locally grown cultivars. Work in all three countries has produced promising outcomes. In Thailand, the Department of Agriculture has established stonefruit demonstration orchards at four farmer sites in Khun Wang province and at four sites in Ang Kang province. At an ACIAR demonstration block on Royal Ang Kang Research Station, crops from trees of peach cv. Tropic Beauty produced about 120–150 fruit per tree, with an average fruit weight of 150 grams (18–22 kg per tree). At a conservative price of 80 baht (\$3) per kg, returns should equal \$23,000 per hectare.

At the World Vision demonstration plots at Ban Kon Pan Village near Chiang Rai in northern Thailand significant **improvements in orchard management** have lifted fruit quality, and newly introduced varieties such Tropic Beauty are performing well. Surveys have revealed that Thai consumers prefer large, highly coloured fruit with high sugar concentrations and low acid. Studies continue to determine how best to raise the understanding of marketing and supply chain management, which should help to implement quality-assurance systems and give better access to export markets.

Earlier ACIAR work helped Thailand to establish a national system of recording and evaluating the breeding and performance of beef cattle and buffalo. This system, which has been run by the Department of Livestock Development, uses a PC software system, 'Herd Magic', to record the data for genetic evaluations to rank animals for genetic merit and monitor genetic progress within and across herds. A new ACIAR initiative has helped to translate the HerdMASTER program (the latest tool on a Microsoft platform) into the Thai language, to enable more efficient data collection.

Two socioeconomic studies are helping Thailand to deal with the intricacies of trade liberalisation and technical change. One

study is examining the impact of sanitary and phytosanitary (SPS) measures (important quarantine considerations) on the ability of agricultural-exporting developing countries to achieve the full benefits of trade liberalisation. The study is designed to provide policy recommendations for further improvement of the current World Trade Organization procedure for SPS dispute settlement, and for enhancing technical, scientific and institutional understanding of SPS measures in India and Thailand.

Thailand is also keen to understand the socioeconomic impacts of recent technology developments. A project is seeking to identify agricultural industries that have shown productivity growth and determine why they have grown—is it biotechnical change, such as improved crop varieties and cultivation methods, mechanisation, management improvements, or other reasons? Researchers are compiling a large data set encompassing eight major agricultural sectors and undertaking statistical analyses of the rate and factor-saving biases of technical progress in each sector.



*Low-chill packing technology developed in Thailand*

# Burma

Active projects in 2006–07	2
AOP budgeted expenditure in 2006–07	\$75,000
Actual expenditure in 2006–07	\$26,582
Expenditure in 2005–06	\$208,998
Expenditure in 2004–05	\$249,412

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Burma



Key performance indicators	Performance 2006–07
Assessment completed of the impact of improved chick rearing and Newcastle disease vaccination on the production and profitability of village chicken-keeping in field locations in Burma	Simple interventions have proven to be robust and well accepted at the village level.

## Position

After exploratory visits in 2002 to determine the feasibility of collaborative research activities, ACIAR developed a small program with Burma and the first projects commenced in 2003. However, with the current international situation, development of new projects is on hold.

## Achievements

ACIAR continued its small program of research cooperation, maintaining the focus on food security and nutrition for villagers. Work continued in the project to **vaccinate chickens against Newcastle disease**. Earlier research made significant gains, and now an extension is consolidating these achievements and ensuring sustainability of the project outcomes.

Extension activities originally started in 2005–06 are now moving beyond the original study site areas and incorporating broader aspects of chicken health. The researchers are increasing awareness amongst village farmers of the economic benefits to village chicken production of chick management and Newcastle disease vaccination. Extension materials (pamphlets, calendars, flipcharts and posters) were developed in the original

project and first extension, and these are being expanded to include materials on village chicken health in general. A plan is being developed to ensure best delivery of this extension message, through farmers meetings and possibly plays, radio or television programs.

A new project commenced in early 2007 is designed to help smallholder farmers of the Central Dry Zone (CDZ) of Burma.

At present they primarily grow legumes with minimal inputs of fertilisers, pesticides and herbicides, and yields are low (about 1.0 tonne per hectare). Their food security, nutritional health and livelihoods could be lifted by **increasing productivity of pulse and oilseed legumes**, and this new project is identifying and distributing high-yielding chickpea, groundnut and pigeon-pea cultivars adapted to the cropping systems of the CDZ. The project team is also seeking to increase the productivity of legumes by selecting and testing high-quality rhizobial inoculants (nitrogen-fixing bacteria that live in the root nodules of legumes). Scientists in the region are also receiving training on legume improvement and inoculant technology.