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IN RESEARCH FOR DEVELOPMENT

## RAISING INCOMES PATHWAYS OUT OF POVERTY



**JOINING THE DEVELOPMENT DOTS  
SMALLHOLDER INCOME CASE STUDIES**

## The productivity dividend

**B**road-based economic growth is a key component of development, creating opportunities for individuals throughout an economy. Where large numbers of people are living in poverty such opportunities can help lift many out of poverty.

In the agriculture sector of many developing countries, opportunity is tied to lifting yields and productivity. For the poorest of the poor, including the estimated 500 million people relying on small farm holdings, increased yields create change.

This change occurs in many ways: increased income, money to spend on children's education and health, the opening of businesses, and the beginnings of free markets. With rises in productivity these and other opportunities are possible.

This edition of *Partners* tells some of these stories of opportunity—from poultry farmers in Tanzania and Mozambique selling chickens to nearby villagers, to oyster farmers in Vietnam attracting the interest of commercial buyers, it is smallholders who benefit.

These stories link to the bigger picture of productivity gains flowing throughout agricultural sectors.

**This edition of *Partners* tells some of these stories of opportunity—from poultry farmers in Tanzania and Mozambique selling chickens to nearby villagers, to oyster farmers in Vietnam attracting the interest of commercial buyers, it is smallholders who benefit.**

In Vietnam, two sectors have experienced change and growth in part through ACIAR investments. Pork is an important source of dietary protein. For poor pig producers productivity gains can create a means to supply this demand and escape poverty. ACIAR's research to improve pig genetics has had flow-on effects, with independent economic assessments calculating the research dividend at almost \$2 billion. Of this, some \$973 million has accrued to smallholder producers, largely through increased income and reduced costs.

Often this is the story, smallholders gaining both at the input and output stages of production. Productivity gains in Vietnam's smallholder forestry sector have mirrored those experienced by pork producers, creating viable pathways out of poverty.

In both cases, what has been unlocked through productivity gains is opportunity. Whether among farmers and small businesses in Bangladesh, poultry farmers in Africa, oyster and pig farmers in Vietnam or fruit and vegetable producers in the Philippines, modest productivity gains delivered through ACIAR research have catalysed markets and created new opportunities that were previously missing.

The long-term dividend from productivity is development—of people and economies. ACIAR plays a strategic role in helping accelerate development, lifting people engaged in agriculture out of poverty. ■

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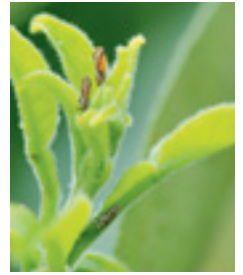


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is spreading across the continent with almost the same tenacity as the virus it seeks to eradicate.

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# INCOMING EARNINGS

This edition of *Partners* looks at the ways smallholder farmers' income has improved through participation in research-for-development projects and the policy and program structures that make it possible.

**"No country has been able to sustain a rapid transition out of poverty without raising productivity in its agricultural sector."**

— PETER TIMMER

THOMAS D. CABOT PROFESSOR OF DEVELOPMENT STUDIES, EMERITUS, HARVARD UNIVERSITY

In Vietnam's Quang Ninh area, Pham Thi Lieu grows oysters using a technique introduced through Australian aid. Recycled shells are tied to a line, which is slung from a raft into the warm, nutrient-rich water.

It takes less than 12 months to grow a commercially acceptable oyster. The oysters earn a farm-gate price of about \$1.40 a kilogram. The income this generates is helping transform Pham's life.

"We have been able to afford a new house, which we built two years ago," she says. "Now we're using the profits to expand our farm. If I have any extra money I will save it for my children and grandchildren."

More than 200 farmers have adopted the same techniques as Pham, introduced

as part of a small ACIAR project. About 5,000 oysters are grown and sold commercially in the area where Pham lives. Most of the families involved in oyster cultivation have been earning between \$1,800 and \$3,000 a year. Another 10,000 farming families in the area could also begin to see the benefits of these simple approaches in the future.

Helping people out of poverty is the purpose of Australia's aid program. ACIAR's research programs introduce new technologies, management techniques and varieties to smallholder farmers, to help boost their on-farm productivity. Increased productivity helps create surpluses, which in turn helps create markets.

For smallholder farmers increases in production have profound benefits, notably through access to markets. The challenge

of getting produce to market is broad, and includes infrastructure, seed funding, access to cash transfers and supporting policy environments. How Australian aid is focusing on these issues is outlined in Australia's Comprehensive Aid Policy Framework.

ACIAR's key role in the aid program is improving food security. Australia has prioritised three pillars of action:

- 1** Lifting agricultural productivity through agricultural research and development.
- 2** Improving rural livelihoods by strengthening markets and market access.
- 3** Building community resilience by supporting the establishment and improvement of social protection programs.

For many farmers food security and overcoming poverty creates a range of possibilities.



The World-Heritage-listed Ha Long Bay in northern Vietnam makes a spectacular backdrop to the many smallholders whose livelihoods depend on fisheries and aquaculture enterprises.



Farmers involved in the ACIAR project on oyster production in Vietnam told their stories of how life has changed using Photovoice. As part of an assessment of the project farmers were given a camera and asked to document the opportunities the project had created for them (see Voices of the Farmers).

Many cited access to basic services, such as health care and education for children, along with increased income to invest in family homes and farms as opportunities the increased income had afforded. Other changes included diversification into other agricultural production, including higher-value products, which has helped build resilience in farming systems that no longer rely on a single, low-earning commodity. Whole villages also experience benefits. Employment opportunities can

expand with new markets. Investment in communal assets, such as a village hall or boat, often occurs.

The results are significant, not only for smallholders such as Pham but also those in nearby villages and communes. The flow of benefits can reach across sectors and regions and help accelerate sustainable economic development within developing countries. Larger countries can become leaders in regional development. The prevalence of agriculture in developing countries makes such gains possible.

At the heart of these gains are smallholder farmers, accessing new technologies that lift their productivity, and begin the process of lifting productivity across agricultural sectors. ■

## VOICES OF THE FARMERS

In October and November 2011 oyster farmers from the Ban Sen Commune in Van Don district, who have been involved in the ACIAR project, were given a unique opportunity. Using a research technique called Photovoice, farmers were provided with cameras and diaries and asked to record their story about the impact of oyster farming on their lives. Their responses were translated and compiled into a report. The full report is available on the ACIAR website. Here are a few excerpts from those involved.

### ON JOBS

- *We wish to have many farms like this to have more jobs for people and improve incomes.*
- *Oyster farming creates jobs for young labourers who are in the age of twenties.*
- *Oyster farming creates jobs for my family and village.*

### ON HEALTH

- *Oysters help improve quality of our family meals.*
- *Oh, what a delicious and nourishing dish! Thanks to oysters, my family meals have more choices and are richer in protein.*

### SOCIAL BENEFITS

- *Oyster farming brings profit. Many families in the village/commune bought karaoke sets. Life is obviously going up.*
- *With money from oysters, a village also bought a shuttle boat to transfer passengers around and about the village.*
- *Since the oyster farming began, many families have been able to build solid houses.*
- *Since the village developed in oyster farming, every family bought motorbikes as transport means for more convenient lives.*

### ON OPPORTUNITY

- *With support from the government for oyster spats, a poor household has developed their farm and got profit. They have money to raise pigs for better income and moved out of the poor-household list of the village.*
- *With oyster farming, villages have money to develop forestry and get obvious profits from eucalypts and acacias.*



PHOTO: BRAD COLLIS

# Joining the development dots

It started as a project to improve the genetics and nutrition of smallholders' pigs in Vietnam. When the project raised productivity and farmers livelihoods, new poverty-reducing opportunities were created and supported by ACIAR. The result was a series of coordinated projects that provide multiple in-built opportunities for poverty alleviation.

## KEY POINTS:

- To achieve long-lasting benefits to smallholder farmers' livelihoods, ACIAR adapts how it designs and rolls out its research-for-development interventions.
- This dynamic, evolving approach to project design is illustrated by a series of pig projects in Vietnam.

## BY DR GIO BRAIDOTTI

Farmers who participate in ACIAR projects and whose income steadfastly improves have compelling stories to tell about their experiences. But back in Canberra, at ACIAR's headquarters, these much sought-after outcomes do not occur by chance or by following regimented procedures.

According to ACIAR, there is no magic-bullet strategy for reducing poverty and promoting

development by tapping agricultural science.

Instead the trend within ACIAR is to use expertise across many disciplines as one integrated palette from which to roll out a coordinated program of assistance, which over time dispenses beneficial innovations across a rural community's production landscape, supply chains and markets.

Designing these projects is an immensely context-specific, regionally engaged, multidisciplinary process. Behind the scene, ACIAR's 12 research program managers (RPMs)—some of whom double as regional coordinators—work with seven country managers and collaboratively with partner countries. Together, they design initiatives best suited to benefit from Australian agricultural expertise and ACIAR's network of international collaborators.

In addition to drawing on technical

knowledge about cropping, livestock, fisheries, aquaculture, forestry and the natural resources and socioeconomics that farming depends on, ACIAR also taps and maintains in-house experience in policy, gender issues, impact evaluation, participatory and continuous improvement research models, training, capacity building and disseminating research outcomes in the developing world.

"Coordinated programs of research, either with a number of projects operating concurrently or a series of linked projects, often result in the most substantial and enduring outcomes for the rural poor," says Dr Peter Horne, ACIAR's RPM for livestock production systems and regional coordinator for Indonesia, East Timor and the Philippines.

"ACIAR looks to identify in advance where a program of work—requiring a range of skills and approaches—is needed in a country.

Rather than addressing that need in an ad hoc way, we set it up from the beginning as a program of work that has a long-term goal but which rolls out in a series of finite research activities. These achieve an end in themselves, but also provide stepping stones for further development and greater overall gains."

A series of Vietnamese pig projects illustrate how this process works in practice and evolves over time.

### LEAN PIGS, FAT FARM PROFITS

The opportunity for the ACIAR intervention in Vietnam originates with productivity gains for the pig meat industry achieved through an Australian scientific breakthrough in pig breeding and nutrition. This is a familiar situation to ACIAR—the agency was built on the realisation that Australian agricultural R&D has much to offer efforts to alleviate rural poverty beyond Australia's shore.

Pigs are a ubiquitous and valuable component of farming systems in Vietnam's north-west, in the scavenging, free-grazing systems in the uplands of Dien Bien and Son La and in the semi-intensive systems in the lowlands of both provinces. They are especially important in the livelihoods and cultures of very poor ethnic minorities, providing meat for home consumption, celebrations and religious festivals. The pig breeds, however, were limiting the farmers' productivity.

Since 1920, local Vietnamese pig breeds—which tend to be small, fat and slow-growing—have been gradually replaced or crossbred with higher-yielding exotic breeds, first introduced into Vietnam during the period of French colonial administration. The exotic breeds are larger, leaner and faster-growing than native breeds.

However, prior to ACIAR's involvement, they were also of low genetic quality, making them poorly adapted to local conditions, susceptible to disease and requiring more expensive feed. The contribution of ACIAR's first Vietnamese pig project was to improve the genetic quality of the exotic breeds.

Dr Cam McPhee led the project that capitalised on the research breakthrough made at the Queensland Department of Agriculture, Fisheries and Forestry (Queensland DAFF, previously the Queensland Department of Primary Industries). His team succeeded in breeding high-yielding pigs adapted to tropical conditions and feed ingredients that allow the efficient production of lean pork.

Dr McPhee explains that previously, producers in warmer areas of Australia—conditions somewhat similar to those in Vietnam—had found that lean pig strains from Europe experienced heat stress that reduced

appetite and growth rates and sometimes causes death.

"We had been working for many years to overcome these problems and the research attracted ACIAR's attention on behalf of poor South-East Asian farmers," he says. "The breakthrough involved a breeding selection protocol that over a number of years results in the development of pigs with a high growth rate, lean carcass, good appetite and high resistance to stress."

To capitalise on this new expertise, the Queensland DAFF Animal Research Institute was commissioned by ACIAR to undertake research in collaboration with James Cook University (JCU) and the Institute of Agricultural Science of South Vietnam (IAS).

The livestock RPM in 1994, Dr Bill Winter, created a project with typical ACIAR twists: it was designed to benefit both Australian and Vietnamese pig producers; and the multifaceted project was designed to deliver self-reinforcing gains for Vietnamese pig producers in the form of improvements to pig genetics, nutrition and the building of Vietnamese pig-breeding capacity, including

through artificial insemination.

Benefits to Vietnam from the partnership with ACIAR were independently evaluated twice, first in 2001 and again in 2008 to include ACIAR's capacity-building activities.

Agricultural economists Hayden Fisher and Jenny Gordon, from the Centre for International Economics, found the net value from all R&D activities initiated by ACIAR was about \$2 billion (in 2006 dollars). That translates to an internal rate of return on ACIAR's investment of about \$119 worth of benefits for every dollar spent.

The benefits to smallholder Vietnamese pig producers—mostly derived from lower pig production costs and improved efficiencies—amounted to an estimated \$973 million.

With a greater capacity to produce more and higher-quality meat came new challenges and opportunities.

### STEPPING STONES TO GREATER MARKET PARTICIPATION

The detail that triggered the evolution of ACIAR's involvement in Vietnam is intriguing for its colloquial nature. Dr Horne explains: "Vietnamese have a very strong preference for fresh pork,

## The big picture

**Taking a bird's-eye view of ACIAR's operations, Dr Peter Horne says he can identify at least four ways that the centre organises its research-for-development work.**

**First, there are individual research projects that target innovations focused on a particular issue. However, ACIAR is responsive to changing circumstances on the ground and over time has the means to implement follow-on projects that respond to emerging opportunities. So a project addressing a technical issue about mango production can lead to work on integrated farm management and then postharvest processing and marketing.**

**"This is the usual way ACIAR has worked in the past," Dr Horne says. "Added to this we increasingly have other options."**

**This includes single projects with large budgets and several technical and market-based components, such as 'Seeds of Life' in East Timor and 'Sustainable Intensification of Maize-Legume cropping systems for food security in Eastern and Southern Africa' (SIMLESA).**

**Third, there are larger coordinated programs that comprise several individual projects all addressing a larger overall goal. An example is the new program in Myanmar, which consists of projects in fisheries and aquaculture, cattle and poultry, rice, crop legumes and socioeconomics.**

**"They all run concurrently and are focused on a coordinated effort at improving productivity and rural livelihoods in two geographical zones of Burma," Dr Horne says. "Another**

**example is the HORT Fruit and Vegetable program in the southern Philippines."**

**A fourth strategy that Dr Horne is cultivating for livestock production systems is investment in long-term research strategies. This is based on the success of projects that evolved into a series of interventions that, in hindsight, could be described as a logical strategy over the longer term.**

**"The argument is that if this is true in hindsight, there must be circumstances we are in now where we could establish a longer-term strategy into the future and design a first project to sit within that strategy," Dr Horne says. "We have started this approach in East Timor. The logic here is that a first project designed as part of a 10-year strategy looks very different from a stand-alone 3-year project."**



which accounts for more than 95% of the pork consumed in Vietnam. Pork makes up 75% of meat consumed in Vietnam and its production delivers substantial benefits to the smallholders who supply more than 80% of the market.

“This has an important implication for ACIAR’s research work. As demand grows there is little opportunity for import substitution with frozen pork. This provides a very significant opportunity for the domestic pork industry to grow.”

However, most pig farms are small and widely scattered: producers with one to five sows account for 84% of all households raising pigs. This small-scale production employs about 4 million people—two-thirds of whom are women. The question for Vietnam was whether smallholders would have a role to play in meeting the growing market demand for pork or whether pig production would consolidate into a large industrial pork-production system.

Helping Vietnam acquire evidence-based answers was an ACIAR project undertaken in Vietnam by the Institute of Policy and Strategy for Agricultural and Rural Development (IPSARD).

Dr Anh Nguyen Phong is IPSARD’s director of external affairs and says Vietnam’s policymakers tended to assume lower economic efficiencies for small-scale pig producers compared to industrial producers. The assumption was embodied in official policy—the Toward 2020 Livestock Development Program—which emphasised developing industrial-scale pig production.

“The second of ACIAR’s Vietnam pig projects provided a lot of evidence to show that small-scale pig producers have their own advantages, primarily the ability to reduce production costs by using their own feed and labour,” Dr Phong says. “That really gives them an advantage and in the same circumstance, the small-scale producer can compete with the large-scale producer to meet market demand.”

IPSARD’s detailed economic models found that instead of the expected 70% market share, industrial production systems were projected to meet, at most, 20% of total supply by 2020.

“The project provided clear evidence to our policymakers about the very important role of the small-scale pig producer in Vietnam,” Dr Phong says.

“Our advice to the Ministry of Agriculture and Rural Development was that we should support policy and technology transfers for both small and industrial-scale production systems rather than emphasise only large-scale producers. Another important policy recommendation for improving the pig sector was to focus on improving the management of the animal slaughter system.”

By November 2011, the Agriculture Minister had taken on board these recommendations and conducted a number of meetings and workshops with the Department of Livestock Development in Vietnam to identify ways to help develop Vietnam’s small-scale pig-producing sector.

“With that project, ACIAR was asking

whether the smallholder producer in Vietnam has a future because there is no point in ACIAR continuing to fund that work if the smallholder is going to disappear,” Dr Horne says. “But they are not going to disappear. So the opportunity now is to diversify project activities in Vietnam so that smallholders can profit from growing market demand.”

Having dealt with on-farm production and technical breeding challenges in the first project and mapped out the policy future in the second project, ACIAR is now funding a third pig project in Vietnam focusing on the supply-chain issues that affect market participation by small-scale pig producers and food safety issues that could create volatility in these chains.

The need for this project arose from a subtle shift in the length of supply chains as markets grow and societies become more urbanised.

“Traditional pork supply chains in Vietnam are quite short—we are talking about a matter of a few hours from slaughter to the consumption of pork,” Dr Horne says. “With greater urbanisation new chains emerge that are longer. What tends to happen with these chains—particularly for perishable products such as milk, meat and vegetables—is that urban consumers become increasingly concerned about food safety.”

With ACIAR support, the International Livestock Research Institute (ILRI) recently examined consumer behaviour in Vietnam in response to concerns about food safety,





PHOTOS: BRAD COLLIS

especially contamination with microbial pathogens.

Ominously for the robustness of smallholder supply chains, pork in wet markets was perceived to be more risky than pork sold through supermarkets, and a large percentage of consumers indicated they would switch to supermarkets if microbial contamination was reported as a safety issue.

However, ILRI's results showed wet-market pork had lower levels of microbial contamination than that sold in supermarkets.

"The results were intriguing," Dr Horne says. "The perception was that supermarkets are safer places to buy pork. Yet people buying from wet markets are cooking the pork quickly and in traditional ways—which is at very high temperatures—reducing the risks to human health substantially.

"Urban consumers, in contrast, tend to be moving to modern ways of buying, preparing and storing food, so that the meat is stored in refrigerators and cooked at lower temperatures."

The net result is consumer behaviour that may expose people to higher health risks despite the change in behaviour being motivated by the desire to reduce risks.

"This has been part of the justification for funding a new project in pork supply chains in Vietnam," Dr Horne says. "This work is focusing on how to manage health risks and disease to make sure that the poverty-reducing benefits to smallholders from participating in those

chains do not collapse overnight because of a perception they are risky to human health."

Those concerns have led to the involvement of a discipline new to ACIAR through the participation of the Hanoi School of Public Health, and might herald greater involvement from public health R&D within ACIAR's future activities.

"This is a good example of how projects diversify from their original foci over time," Dr Horne says. "As you can see, we are still working with pigs and the pig industry in Vietnam but we are changing our focus to address—as a series of projects—the evolving issues of smallholder productivity and market participation. Through those activities, we also support the capacity building of our Vietnamese partners across a range of aspects of those chains."

#### A PREFERENCE FOR COORDINATED PROGRAMS

Coordinated project series are also attractive to ACIAR's Australian partners—the agencies that are often responsible for implementing ACIAR projects—precisely at a time when ACIAR is realising it has a role to play strengthening Australian R&D capacity.

"If Australian agencies see there is a larger, coordinated and longer-term program, as opposed to an individual project, then that is much more attractive for them to co-invest in the staff with the skills required," Dr Horne says.

ACIAR projects also play a role for young scientists, providing incentives to pursue careers in agriculture, fisheries and forestry.

"Increasingly Australian agricultural research agencies are finding it difficult to attract and retain top-quality graduates," Dr Horne says. "ACIAR has a more active role to play here. We recognise that for many young scientists, the chance to be involved in research in other parts of the world is a strong incentive to pursue careers in agriculture, fisheries and forestry." ■

**More information: The project evaluation—*Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts*—has been published in the ACIAR Impact Assessment Series (Report No. 52, May 2008) and can be downloaded from the ACIAR website ([www.aciar.gov.au](http://www.aciar.gov.au))**

#### PARTNER COUNTRY VIETNAM

**PROJECT 1: LPS/2002/079 – Utilisation of local ingredients in commercial feeds for pigs**

**PROJECT 2: LPS/2005/063 – Improving the competitiveness of pig producers in an adjusting Vietnam market**

**PROJECT 3: LPS/2010/047 – Reducing disease risks and improving food safety in smallholder pig value chains in Vietnam**

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# Fruit and vegetables boost economic health

Fruit and vegetables have long been touted for their health benefits. In the Philippines the virtues of horticulture now include the ability to lift rural communities out of poverty.

## KEY POINTS:

- **Across the Philippines, smallholder farmers have the opportunity to tap agricultural science to improve farm profits from growing fruit and vegetables.**
- **Assistance ranges across the supply chain, from better managing soil nutrition, pests and diseases through to establishing innovative marketing strategies.**

BY DR GIO BRAIDOTTI

**D**espite economic growth in the Philippines of 5% during 2003–09, the number of people living in poverty increased from 20 million to 23 million. In all, there are now 45 million Filipinos living on less than \$2 a day.

Underlying these figures is a stark new reality for poor rural communities: there is relatively little new land available that is without disputed ownership or generally suitable for expanding agricultural production. In addition, relative productivity growth on existing farming systems has been low.

In May 2008, ACIAR launched the Philippines Horticulture Program, a multidisciplinary series of engagements with smallholder farmers that leverages Australian and Philippine R&D capability to identify opportunities across the supply chain to improve farming profitability.

The program is run in conjunction with the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) and includes innovations that better link production practices to market demands and standards.

Les Baxter, ACIAR's research program manager for horticulture, says the situation in the Philippines is increasing pressure on Filipino farmers to diversify.

"Income-generating horticultural crops have strong potential but have been held back for a range of reasons," he says. "These include farmer knowledge gaps about horticultural practices and innovations all the way through to the need for ways to mitigate climate and locality

impacts, such as heavy rainfall on sloping land."

While rice is the Philippines' dominant agricultural crop, ACIAR undertook an extensive country consultation process with PCAARRD and looked at a range of food and income-producing crops—especially for increasingly marginal lands in the uplands—and found it was fruit and vegetables that presented realisable opportunities to raise farmers' income.

To better leverage horticulture's poverty-reducing potential, the Philippines Horticulture Program recruited the assistance of 27 research organisations from the Philippines and Australia and 55 key researchers. They have dealt with a broad range of production and post-farm-gate issues, from developing integrated crop management systems with reduced chemical requirements and optimised fertiliser use, through to improving postharvest handling, quality, sanitation, marketing and competitiveness.

Dr Pat Faylon, PCAARRD executive director, says that increasing the market competitiveness

of horticultural products can be achieved by linking smallholders to markets and introducing or expanding horticultural crops to achieve greater diversification.

"The Philippines horticulture program has been helping smallholder farmers to overcome key barriers to adoption of improved practices for higher value fruit and vegetable crops. Linking these farmers into local, domestic and international markets has significant potential to increase their livelihoods."

With support tailored to specific production and market conditions, the program's impacts on the ground have been as diverse as the program's design.

## PULVIO CABILLADAS: GROWING MORE WITH LESS

The Northern Mindanao region was identified by the Philippines Horticulture Program as an area with great potential for expanding vegetable production. However, realising that potential was contingent on best-practice



Pulvio Cabilladas has seen his income rise and costs fall since getting involved in an ACIAR project.



management options for managing soil fertility, including the use of fertilisers.

In the region's landlocked Bukidnon province, Pulvio Cabilladas grows and sells broccoli, cabbage, cauliflower, Chinese cabbage, sweet peppers and tomato to support his wife and five children. When the ACIAR-PCAARRD project was introduced in his community in 2008, he quickly signed up, seeking to learn more about vegetable farming and ways to improve his production system.

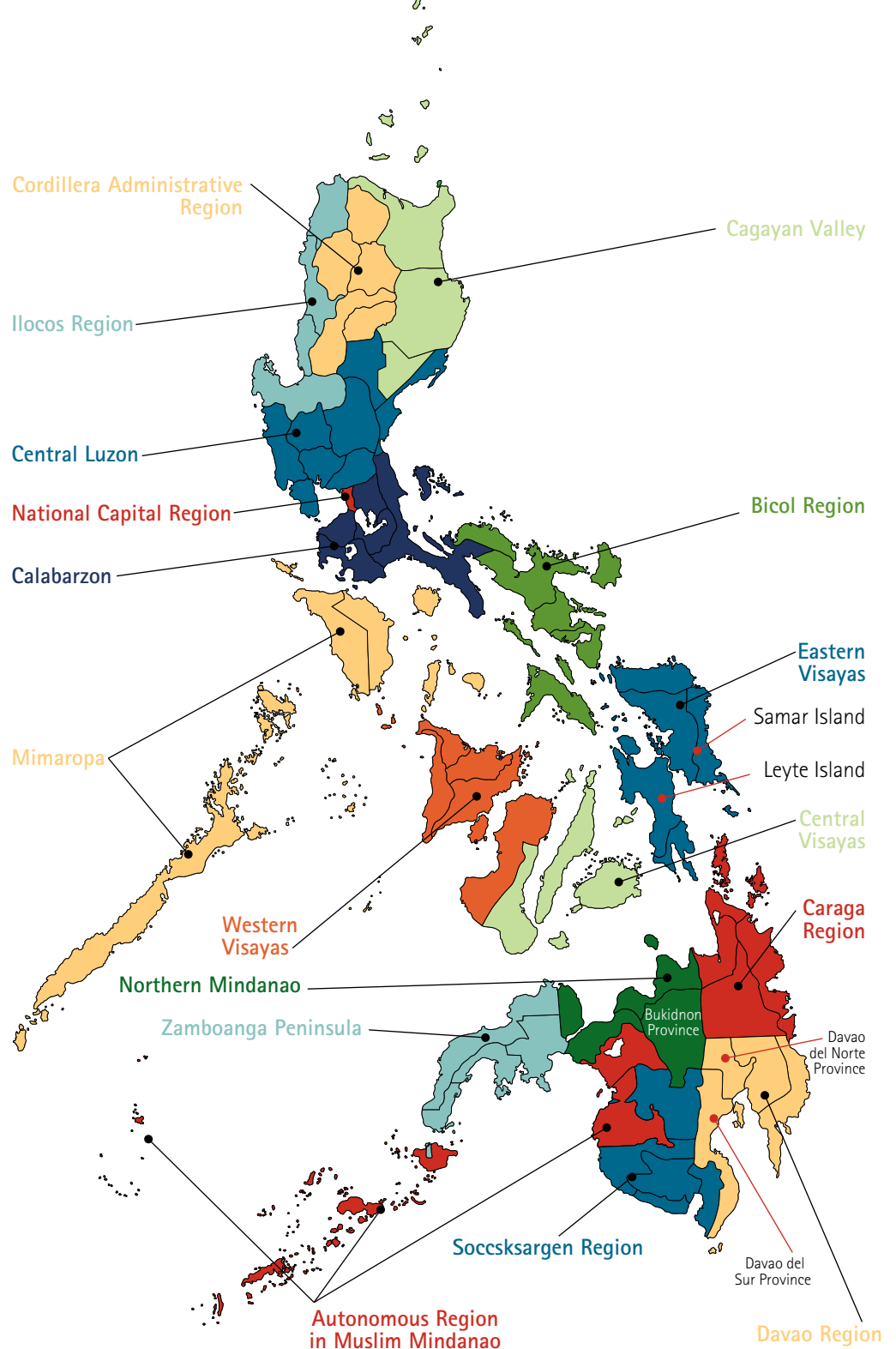
Soil fertility on Mr Cabilladas's 4-hectare farm was assessed as part of the project. His farm also hosted trials that compared his fertiliser and nutrient management practices with new and different treatments, including the use of alternative organic fertilisers.

Dr Chris Dorahy, from soil consulting firm ableblue Pty Ltd, was involved in these activities and heads the 'Vegetables Component 1' project of the Philippines Horticulture Program. He says that the region's farmers face increasing fertiliser costs, and that inappropriate nutrient-management practices can result in low yields when too little is applied or, if too much is applied, potentially damaging run-off into surrounding areas and waterways.

"Although trials are still ongoing, results are promising," Dr Dorahy says. "Mr Cabilladas has cut costs in buying fertiliser and has reduced fertiliser application by 73%. Even with less fertiliser, he continues to harvest 12-15 tonnes per hectare—almost the same yields as when he was applying more fertiliser."

Mr Cabilladas has seen his income increase by 20% and his neighbours are now very keen to establish trials on their own farms.

Figure 1 Regions of the Philippines



Joveniano Horio and Dr Sylvia Concepcion from the University of the Philippines Mindanao promote a new agricultural cluster, with some members seeing their incomes increase by up to 200%.



#### JOVENIANO HORIO AND JOHN VILLANUEVA: CONNECTING FARMS TO MARKETS

Joveniano Horio Sr from the Davao region in the southern Philippines earns a minimum income growing coconut, rice and maize. He spares a small amount of income to care for his vegetable garden, which consists of bitter melon, okra, string beans, Malabar spinach and eggplant.

His is one of 5.7 million farming households across the Philippines that grows vegetables. The discordant note for ACIAR is that 80% of these households are on the borderline of poverty, earning less than 3,000 Philippine pesos (PHP) (A\$70) a month. Low income limits farmers' ability to buy seed and other inputs, which in turn causes low resilience to

natural disasters, common in the Philippines. Knowledge gaps, especially regarding pest and diseases, negate opportunities for improvement.

These constraints are compounded by the low prices that traders dictate for the farmers' vegetable crops.

Dr Peter Batt, of Curtin University of Technology, heads the 'Vegetables Component 4' project of the Philippines Horticulture Program. He first met Mr Horio in August 2009, along with other farmers in the community of Barangay Saloy in the Calinan district of Davao City. They decided to form a cluster through an eight-step research and development approach used by the Catholic Relief Services (see box, page 13). Mr Horio served as their leader.

"He learned more about farming, particularly in planting vegetables," Dr Batt says. "Forming the cluster improved the relationships among farmers and eased the tension brought about by differences in political affiliations. Most importantly, they gained negotiating power and are now able to sell directly and at a higher price."

Together, the cluster selected the main vegetables to sell and interviewed prospective buyers. With the farmers' combined yield, they were able to make their first delivery to Bankerohan Public Market in Davao in January 2010. Forty neighbours are now interested in joining the cluster.

Since the creation of the agricultural cluster in 2009, Mr Horio and his Barangay Saloy cluster have federated themselves with two other local agricultural clusters to expand their network and manage common challenges and opportunities.

Production constraints for John Villanueva presented a different puzzle for researchers. He farms on the sloping land of South Cotabato, in the Mindanao region.

The 46-year-old father of 10 used to earn only about PHP3,000 (A\$70) a month planting corn on his 4 ha farm before becoming chairman of the Ned Landcare Association in 1999.

The Landcare Foundation of the Philippines, Inc (LFPI) is an organisation that uses a people-centred approach for extension, bringing all key stakeholders in the community together to learn and jointly address a broad range of livelihood issues that confront them.

LFPI has a long history of partnership with ACIAR, providing extension, training and community development assistance in various programs. In the Ned Landcare Association, the focus was on the introduction of the conservation practice of contour farming using vegetable strips to prevent soil erosion. It is a practice that incorporated legumes and other high-value crops, such as fruit trees as

hedgerows, to better manage the land.

"The Landcare group faced a number of market challenges," Dr Batt says. "They had limited buyers and an oversupply of vegetables. They delivered their products individually to traders in Isulan and Lambak in Sultan Kudarat, which was laborious and costly.

"With little knowledge in marketing requirements and colour classification, they sold sweet pepper at a low price to traders. Farmers who depended on traders to finance their production inputs had to sell to their financiers."

Starting in 2008 the farmers were trained in conducting a market-chain study that included interviewing potential buyers. They formed a sweet pepper cluster and were linked to a tuna canning company and a financing cooperative.

"The cluster became knowledgeable about market requirements and linkages, and now know where to sell their produce to assure good market returns," Dr Batt says. "In one year they sold 55% of their produce to the tuna company and 45% to local buyers."

Training in marketing, vegetable production, and pest and disease management further helped farmers meet market requirements, while marketing costs decreased upon selling their produce as a group.

By shifting production from corn to sweet pepper, Mr Villanueva was able to double his income; some of his cluster colleagues recorded as much as a 200% increase. ACIAR involvement allowed Mr Villanueva to visit local and institutional buyers, attend seminars and undertake training. In recognition of his role as a leading local grower he was recently a guest speaker at a Mindanao vegetable congress. The empowerment of these agricultural clusters and their members is one of the key factors in sustaining their livelihood development.

### LEO CASTILLO AND RODILLO CANDIDO: LIFTING THE DISEASE BURDEN

The tallest mountain in the Philippines, Mt Apo in the Davao province in Mindanao, may be one of the country's most popular climbing destinations, but sadly its forests are being cleared. Soil-borne diseases are making it necessary for farmers to plant crops in higher areas where infectious pathogens are absent.

Bacterial wilt is Mindanao's most important disease of 'solanaceous' crops—plants in the nightshade family, which include *Capsicum* (peppers), *Lycopersicon* (tomato) and *Solanum* (eggplant and potato). While many farming communities are aware of this disease, they do not know how to manage it.

Such was the plight of Leo Castillo, a farmer from Kapatagan, Davao del Sur. He has bacterial

wilt in the soil of his 6.5 ha farm where he plants vegetables such as potatoes all year round. In Mindanao, potatoes are among the most valuable vegetable crops, yet many farmers have opted to grow bananas and other crops because potatoes are highly susceptible to bacterial wilt.

Farmer field trials made possible by the Philippines Horticulture Program enticed Mr Castillo to try biofumigation of his potato farm. This was done by chopping and shredding the leaves from his broccoli and cabbage crops and incorporating them into the soil during land preparation. The soil was then watered to allow the leaf tissue to produce gas that kills the bacterial wilt organism. Healthy potato seeds were also provided.

The biofumigation reduced bacterial wilt incidence to about 4%, which was significantly lower than the untreated areas. The treated areas not only had lower incidence of wilt, but also recorded higher yields. There was an overall improvement in the quality and volume of potatoes produced.

Mindanao also hosts almost 60% of the Philippines' production of the distinctively smelly, but heavenly tasting, durian fruit. Despite the popularity of this tropical delicacy, there is a large unsatisfied demand that farmers cannot meet due to difficulties controlling yet another disease, *Phytophthora*.

Durian grows abundantly in the middle and southern part of the country as a prized tree that commands extraordinarily high prices at local and export markets. However, *Phytophthora* is causing infections so severe that many farmers have been forced to cut down their durian and jackfruit trees and plant other crops instead. The disease affects all stages of the cropping cycle and causes the vital tree parts to wither and eventually die.



Leo Castillo benefited from farmer field trials made possible by the Philippines Horticulture Program, where he learnt about the use of biofumigation to control disease on his potato farm in Kapatagan, Davao del Sur.

PHOTO: JOHN OKESHOT



PHOTO: JOHN OAKESHOTT

Since adopting protected crop structures Noel Morales has been able to earn a living from his farm, rather than rely on labouring for others for an income.



A branch of the Philippines Horticulture Program is helping farmers, particularly on the islands of Leyte and Samar, build structures from cheap, local materials to protect crops during the wet season.

PHOTO: GORDON ROGERS

Rodillo Candido is the farmer from Davao del Norte who won the Best Farmer award in the 2008 Annual Durian Festival, and won again in 2009, in the Best Formed Fruit category. Despite the awards and consistent good production, his farm was not spared as *Phytophthora* gradually encroached into his orchard.

After attending a stakeholder workshop organised by the Philippines Horticulture Program, Mr Candido agreed to participate in trials led by Professor David Guest of the University of Sydney to learn more about durian production and how to solve his *Phytophthora* problem.

“Our objective is to improve the health of the tree by managing its pests and disease because the farmers are more interested in producing a lot of durian and jackfruit,” Professor Guest says.

Chicken dung and selected micro-organisms applied at the base of Mr Candido’s durian trees proved effective, promoting better growth and no new infections compared with untreated trees. In addition to his usual management practices, other strategies such as collection of infected fruit and improved drainage were trialled and also proved effective. Flowering also occurred earlier and yield was higher.

After the intervention, his 126 trees bore more than 5.5 tonnes of durian, which was 1 tonne higher than the previous season.

Another significant result was the field testing of the ground seeds of a common local garden flower, African balsam (*Impatiens* spp.). This natural and readily available remedy has shown strong efficacy and control of *Phytophthora* when applied as a paste onto the diseased areas of the tree.

#### NOEL MORALES: BUILDING A SANCTUARY FOR CROPS

Yet another branch of the Philippines Horticulture Program is helping farmers plant crops during the wet season, particularly on

the Philippine islands of Leyte and Samar, when from June to February heavy rains and damaging winds can destroy vegetable crops.

The project has important socioeconomic benefits for vegetable farmers such as Noel Morales from Leyte in the Visayas region. Previously during the wet season, Mr Morales found non-farm work to earn a living, since heavy rain affects the highland vegetable farms in Cabintan, Ormoc City, where Mr Morales manages his parents’ 6 ha plot.

The solution was to use protected crop production systems and structures, an approach already being used by project collaborator the Visayas State University.

On a parcel of Mr Morales’s farm, tomatoes were grown under structures designed and built from cheap, locally sourced materials, such as bamboo and coco lumber. Best cultural management practices such as fertilisation, irrigation, pest monitoring and control were applied. Under the structure, drip irrigation and plastic mulch were installed.

The structures protected the crops from heavy rains while nets around the structures barred strong winds and insects. This meant pesticide use was reduced, while losses from severe fruit fly and fruit worm damages were also reduced.

The result was a remarkable increase in yield of high-quality, marketable fruits. Marketable yield more than doubled compared with production in the open field.

For the broader community the potential is great for protected cropping to expand in the region and to supply a high-value commodity: pesticide-free vegetables that reach markets at a time of year when production has traditionally been low.

These simple, low-cost production systems are now being replicated by other organisations involved in community development on the islands of Leyte and Samar. ■

### The clustering approach

**A cluster is a group of agencies that work together towards common developmental objectives. The cluster approach is designed to strengthen effectiveness, response capacity, coordination and accountability by strengthening partnerships in key sectors of a humanitarian response. In 2006, it was made part of the United Nations Humanitarian Reform process to improve coordination while enhancing partnerships among different sectors, including aid agencies and non-government organisations.**

**An agricultural cluster is a geographical concentration of farmers and their associated agribusinesses and institutions that are networked to build value to a particular agricultural product by addressing common challenges and pursuing common opportunities. The agricultural cluster not only creates production volume to attract buyers, but can also develop cooperation within the cluster group and across their network that can lead to innovations and sustainability. In the Philippines, ACIAR and partner organisations have been facilitating the development of agricultural clusters.**

#### PARTNER COUNTRY THE PHILIPPINES

**PROJECT 1: HORT/2007/067 – Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia**

**PROJECT 2: HORT/2007/066 – Enhanced profitability of selected vegetable value chains in the southern Philippines and Australia**

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# Blessings from the field

Transforming farming techniques in rural Bangladesh is helping farmers to cut their costs and increase production, while also offering others a way out of poverty.

BY MANDY GYLES

In densely populated Bangladesh, a culturally diverse country of 150 million people, about 64% of people are farmers. Many struggle to provide their families with the basic necessities of life. Since 2006 ACIAR has helped to introduce more sustainable cropping practices to Bangladesh. Minimum-tillage techniques, widely used in Australia, are helping farmers to save costs and are also opening up new business opportunities for others.

## A FINE BALANCE

"North-western Bangladesh is one of the poorest regions in the country," says ACIAR project leader Professor Richard Bell of Murdoch University. "They have regular food shortages, and because of a move to grow more rice and wheat, there have been fewer protein-rich pulses grown. The farms are very small (about 0.6 hectares), but they are very productive, regularly growing three crops a year. The farmers carefully manage their scarce resources to feed their families and to make a profit.

"Our project reached out to many of the poor farmers in the region to see if a range of research outcomes could help. One of the strategies was helping the farmers include an additional pulse crop such as chickpeas and lentils into their crop rotation. And by introducing minimum-tillage farming they have been able to reduce their fuel costs by 70% and grow their crops with 30% less labour."

The end result is that more nutritious food is being grown and profits are increasing.

## VERSATILE MULTI-CROP PLANTER

Essential to this work has been the adaption of minimum-tillage planters for Bangladeshi conditions, work led by Dr Enamul Haque of iDE Bangladesh (formerly a cropping systems

### Little mill that could

Farmers in the Rajshahi area now process small quantities of nutritious pulse crops to meet their families' needs at a mini mill funded by ACIAR.

"Many Bangladeshi farmers were not growing lentils and other pulse crops because the big mill did not allow the dehusking of small quantities," Dr Enamul Haque says.

"We developed a small mini mill that cost about 20,000 taka (A\$240). Now the farmers bring in 5 kilograms of lentils, chickpeas or other pulse crops for dehusking. More mini mills are now being manufactured for other areas."

agronomist with the International Maize and Wheat Improvement Center).

“Traditionally, our farmers plough their lands four to eight times to prepare it for planting crops such as rice, wheat and mungbeans. This is time-consuming and costly, and it also destroys soil structure,” Dr Haque says.

“I began investigating the opportunity for conservation agriculture practices when I visited many farms and field days in Australia in 2007. The Australian farmers were using very big machinery—10 to 20 metres long—but that type of tractor is not useful in our country due to our farm sizes.

“I could see that conservation agriculture offered a lot in terms of reducing production costs and the opportunity to maintain soil health and improve productivity,” he says. “With ACIAR support, we did some research and developed a planter for two-wheel tractors to help farmers plant crops mechanically with minimum tillage.

“It’s called a versatile multi-crop planter (VMP) and it has five specialties. It can do zero tillage, it can do strip tillage, it can form beds and plant on top of the beds, it can do single-pass shallow tillage—even, if necessary, this planter can be used for a conventional tillage system,” Dr Haque says.

Dr Haque has helped spread the conservation agriculture approach in Bangladesh. “The main purpose has been to teach people how to use the multi-crop planter, and how to manage their crops in a better way,” he says.

The planter is now being produced in Bangladesh for use locally and for export around the world. There are now about 350,000 two-wheel tractors operating in Bangladesh that could be modified to use planters.

## TRANSFORMING LIVES

“While many farmers are benefiting through conservation agriculture, some of the biggest beneficiaries have been the people who have become machinery contractors,” Professor Bell says. “It has allowed them to transform their families’ lives from being very poor to being financially secure.”

Sree Shanaton Kumar Biswas operates one of the planters, providing services to nearby farm families.

Becoming a contractor has turned around the fortunes of his family. “I used to be a farm labourer, then I sold clay pots to make money. We were very poor. We often didn’t have enough food or good clothes,” Mr Biswas says.

“I went along to one of the meetings about the planter. We decided to buy one. There was a huge demand for the planter from the farmers. I



After the special puja ceremony Sree Shanaton Kumar Biswas sits with the Brahmin priest in front of his tractors outside his home in Sonaikuri village.



Sree Shanaton Kumar Biswas stands in a plot of land he ploughed with his tractor before the year’s crop was sown. Shanaton and his family have been able to receive a greater income from the addition of the two-wheel tractor, which was purchased with ACIAR support.

had to have three drivers and we were working day and night to meet demand. I made 80,000 taka (A\$950) that year.”

Since then Mr Biswas has paid back his loan and has purchased 1.3 hectares of his own cropland.

As a result of his success, Mr Biswas is now a respected member of the community. His family has enough food, can pay for their children’s school fees and have become farmers in their own right.

Mr Biswas and his family are so grateful for the opportunity to turn their lives around that they had a blessing for their tractor.

“I have given blessings to the gods many

times, but they did not change my life. This planter has changed my life, so I have given blessings to this planter.

“This machine is helping to improve our lives, because it is the source of our income. So we felt we should satisfy it like a god, so we blessed it so that it can be more productive.”

More than 3,000 small contractors like Mr Biswas are now providing services to 150,000 farmers in Bangladesh. ■

**More information: View a video on the versatile multi-crop planter and how Mr Biswas’s experience as a contractor has benefited his family at the ACIAR website ([www.aciar.gov.au](http://www.aciar.gov.au))**

A farmer demonstrates the effects of changes in fertiliser, with a small plot where no phosphate was used still bare earth. She describes this to her fellow farmers as “no phosphate means no mustard crop”.

# WOMEN HARVEST FARMING INNOVATION BENEFITS

PHOTO: PETER CORNISH

A participatory model for rural development that encourages women to redefine their roles in the family and the community is being scaled up to spread the benefits from an ACIAR watershed development and cropping systems project in East India.

## KEY POINTS:

- **Lowland rice cultivation practices that were inappropriately transplanted to upland landscapes are a cause of poverty in rural East India.**
- **ACIAR has identified ways to improve farming outcomes through innovations to water management and cropping systems.**
- **Empowering women to lead the uptake of innovations has proven the most effective way to achieve social benefits from these technical innovations.**

## BY SARAH CLARRY

In 2011, for the first time in human history, more people were living in cities and urban areas than in rural areas. Urbanisation is expected to accelerate into the future.

Many poor people also shift between rural and urban areas, migrating on a seasonal basis. Such people cannot earn enough income from

their small farms, or have no access to land and rely on manual work.

In Amagara village, in India's Purulia district of West Bengal, many residents migrate in search of work on a seasonal basis. The majority are men and older boys who leave for up to six months, travelling to nearby cities and towns. In some cases whole families migrate to neighbouring rural areas to work as labourers.

Women are often left behind with responsibility for managing farms or for seeking employment as day labourers for wages.

The main factor that drives the seasonal migration is low productivity of the traditional Kharif (rainy season) rice.

Kharif rice is grown mainly on terraced and banded uplands. Average yields are low, making food security a critical issue for the majority of people living in the region. Annual rainfall averages 1,100–1,600 millimetres and rice is grown in the monsoon season when

rainfall is highly variable. Climate change and associated risks are adding to the variability, entrenching factors that drive seasonal migrations.

The monsoon provides high levels of water during a short period. If this water can be captured, then the earning possibilities for farmers and labourers could change.

In Amagara village, Dungi Tudu and her husband Jamiswar do not own land. They used to go to Burdwan to work as agricultural labourers for most of the year due to an absence of livelihood opportunities at home.

Even with land, seasonal migrations are part of life. Durgamoni Hembram and her husband Sukumar would migrate every year as their paddy provided only 6 months worth of food for their extended family of eight.

This has changed through an ACIAR project.

In partnership with PRADAN (a local non-government organisation), the Indian Council





PHOTO: BILL BELLOTTI

In Chaibasa, a farmer takes a break from weeding to pose proudly beside her wheat crop, judged the best in the village in a recent competition. Chaibasa is one of the more successful villages in Jharkhand, with some irrigation infrastructure providing a degree of certainty to its local farmers.

of Agricultural Research and the Australian National University, ACIAR sought to improve water-harvesting practices on the East India Plateau and link this to research on soils and agronomy, all the while engaging more effectively with farming communities.

In so doing, they have allowed farmers to broaden their scope beyond traditional Kharif rice and opened up the possibility of year-round agriculture with crops such as vegetables, wheat and mustard, as well as direct-seeded aerobic rice for land that is too risky for traditional rice.

### TRADITION VERSUS MODERNITY

"One thing that surprised me scientifically was the extent to which traditional rice condemns farmers to failure in this area, but at the same time there is abundant rainfall to safely grow other crops," former project leader Professor Peter Cornish says.

Rice has historically been the staple crop. There were good technical reasons for this: it grows well in the lowlands where it achieves modest yields with little or no fertiliser and weed management is easy.

"Population pressure caused rice to be

grown widely on the sloping upland, which comprises most of the land owned by poor families," Professor Cornish says.

"Farmers have tried to adapt the technology from the lowlands to the terraced uplands, but there is often insufficient rainfall for transplanted rice here. That led us to develop the technology with farmers to grow rice more safely and to try alternative crops for the Kharif, as well as develop rainfed and irrigated crop options for the non-rainy season (Rabi)."

Where poor farmers diversify out of transplanted rice they need to learn how to manage the risks: climate, market, cash flow, pests and diseases. One of the best ways to improve livelihoods is to grow vegetables, especially if they are grown when supplies to the market are lower and prices are higher. However, that strategy introduces risks as it involves cropping when conditions are more difficult, such as during Kharif. It also requires a willingness to think in new ways and to embrace change.

One of the biggest changes was to the role women played in farming.

For Professor Cornish and Professor Bill Bellotti, who was also involved in the initial research, a remarkable discovery was the profound effect achieved across a range of areas by involving the village women.

"Every step of the way, women as well as men were involved in training, decisions on research priorities, conducting experiments, interpreting results and explaining them to other farmers," Professor Cornish says.

"Better decisions tend to be made when women are involved because they consider the broader family needs. That's what the project did that was new—it engaged with the women as farmers, rather than merely as members of a self-help group."

The distinction is an important one, as it fundamentally redefines the role of the woman in the family unit and empowers her to make decisions that have far-reaching effects on the family's livelihood and wellbeing.

### WOMEN TAKE THE LEAD

Among the rural poor, women are marginalised, yet they often prove to be the most effective agents for development. When family economic circumstances improve—and if women have a voice in how the money is spent—women tend to first invest in their family's health and education, then in capacity and labour-saving (such as a bike or mobile phone), facilitating a virtuous cycle of gains in the family and wider community.

PRADAN recognises this. To improve livelihoods, they use a participatory approach

across a network of well-established women's self-help groups (SHGs). Traditionally these groups have addressed microfinance and gender issues, including health, but not technical innovation.

ACIAR saw value in the integrated community approach championed by PRADAN and in the focus on the optimal use of resources to reduce vulnerability.

Following initially poor project implementation by participating male farmers in the villages of Amagara and nearby Pogro, the project engaged intensively with the women's SHGs in a way that was new, with PRADAN managing implementation of the research.

Professor Bellotti says that the ACIAR project engaged the women as partners in research. "The ultimate outcome of this innovative process was that the agricultural research process provided the context for women to see themselves as farmers—decision-makers—rather than just farm labourers.

"Although the process is intensive, requiring significant investment in time and expertise, the outcome of developing local capacity for independent innovation is long-lasting and many-faceted."

Farmers in two villages helped develop and adopt new crop options and improved agronomy. These more intensive and diverse cropping systems use land and water resources more effectively. Findings were then scaled out to more than 2,700 families for evaluation.

A clear project lesson is that implementation improves when women are engaged equally with men in learning about agricultural innovation and decision-making about how to improve livelihoods.

A driving force behind the success of the East India Project was the husband-and-wife team of PRADAN's Avijit Choudhury and Kuntalika Kumbhakar.

"Avijit and Kuntalika have developed a wonderful way of working with women that gets them first thinking about their role in the family," Professor Cornish says.

Although women undertake much of the farm labour, they regard their husbands as the farmers and decision-makers. Mr Choudhury encourages the women to reflect on the work they do and reach a point where they start to make the decisions alongside the men.

Participants found that both the self-image of the women involved and the perception of them by their peers—other villagers, salesmen, government officials—were profoundly altered.

"The village men have been surprised at what the women have achieved," Professor Cornish says. "Men will say, 'We didn't know women could do that.'"



PHOTO: BILL BELLOTTI

Locally produced food being sold on the roadside. Vegetables in season that are surplus to requirements can help to provide a cash income and improve livelihoods for farmers.

Much of the experimentation with new vegetable crops and production seasons has been undertaken by women farmers alone and has proven very successful. Their willingness to undertake these initiatives demonstrates new-found self-confidence and capacity for autonomous learning.

When the process culminates in improved livelihoods it means a reduced need for seasonal migration, which enhances the family's social condition.

While Professor Cornish acknowledges that in many ways it does threaten the established order, he says that when the family is more prosperous, the men do not appear alienated by the women's expanded role in the family enterprise.

"When women begin thinking 'I'm a farmer', not only does their self-perception change, but the perceptions of others about them change as well," Professor Bellotti says. "The effect is that they can now access more equitable loans, get a fair rate and protect themselves."

Ms Tudu and Ms Hembram were among those involved in the project. A loan from her SHG made it possible for Ms Tudu to lease land and PRADAN provided training and made it possible for her to participate in field demonstrations, pesticide and fertiliser workshops, and result-sharing meetings.

The family's effort translated into cash income of more than 30,000 rupees (A\$520) from tomato, eggplant and bottle gourd, even after deducting their initial investment of 4,500 rupees (A\$78).

"I always dreamt of cultivating my own plot as I worked in others' fields," Ms Tudu says. "I learnt from the results-sharing meetings that

use of the right kind and dose of fertilisers could increase crop yield significantly."

Ms Tudu and her husband no longer migrate in search of opportunity and work. Amagara is home year-round for the family.

Ms Hembram first participated in the ACIAR project in 2007 as part of mustard cultivation trials that also included information about fertiliser use.

"My expense on fertilisers has come down as I am using potash instead of diammonium phosphate," she says. "I am also using pesticides to minimise the harm caused by pests and have a better knowledge of nutritional requirements of the land."

Applying this enhanced understanding has not only led to an enhancement of her paddy production but also to a new-found interest in agriculture, particularly the cultivation of vegetables.

Mr Choudhury says that although the subdivision of land among the extended family resulted in a small holding, Ms Hembram enthusiastically participated in ACIAR activities and took up tomato cultivation on a large scale.

In 2008 and 2009, on land leased from Haradhan Hembrom, Ms Hembram and her husband tried cultivating various vegetables such as chilli, cow peas, bitter gourd and maize. Drought struck in 2010, but in 2011 the couple renewed their efforts, in partnership with Pashupati Mandi, among others, and cultivated tomato, maize and cauliflower. They earned a substantial income: more than 20,000 rupees (A\$350).

"With tomato I received the maximum profit, which I invested in my brother-in-law's marriage, apart from saving for seeds, pesticides

and fertilisers," Ms Hembram says. She is also able to afford to send their two sons to a private school for a better education. Other major investments over the past 4 years have included a water pump, the purchase of a bullock and housing improvements.

"It all seemed quite unbelievable to some of the women in the SHG as they could not even dream of such a huge gain," Mr Choudhury says. "There are setbacks along the way, however, and then people are compelled to work again as wage labourers."

Professor Cornish agrees that landless and marginal farmers can have the best stories but they are also very vulnerable. "They tend to lease poor land, which they have learned to use productively, often for vegetables, but as they start to do well landlords decide to either discontinue the lease for a variety of reasons or they may raise the rent.

"Similarly, a farmer may embark on development by buying excess water from a wealthy farmer for irrigation, only to have the supply later revoked. There is little protection for poor farmers where land and water markets are undeveloped."

Mr Choudhury explains that the success of the vegetable trials and their rapid adoption within the village changed people's perceptions of local land resources.

"The uplands were previously perceived as fallow and unproductive," he says. "Their suitability for growing vegetables in monsoons [since water cannot accumulate in them] saw the land become highly prized. This impacted Dungi negatively as she was unable to take land on lease to cultivate vegetables as it was leased to a fellow SHG member on better terms."

Outcomes are hard to predict, with some interesting twists along the way, as in the case of the Hembrams. The interest in agriculture fostered by the project created an unexpected new opportunity: Mr Hembram is now actively engaged in motivating and supporting other farmers in his village in his new role as an agricultural service provider. ■

#### PARTNER COUNTRY INDIA

**PROJECT 1: LWR/2002/100 – Water harvesting and better cropping systems for the benefit of small farmers in watersheds of the East India Plateau**

**PROJECT 2: LWR/2010/082 – Improving livelihoods with innovative cropping systems on the East India Plateau**

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# African women adopt vaccine in fight against poverty

A successful ACIAR program established 16 years ago to vaccinate village chickens in Africa against Newcastle disease, which can wipe out entire flocks, is spreading across the continent with almost the same tenacity as the virus it seeks to eradicate.

Dr Robyn Alders visits Singida village, Tanzania, in July 2012. "I had just been given this rooster as a gift by Asha, our star community vaccinator. I asked her to keep the rooster for me and said that I looked forward to viewing its progeny on my next visit." Asha is at rear, wearing a yellow cap.



PHOTO: SALLY INGLETON

BY ALEXANDRA ROGINSKI

Sometimes the yearly cycles in poor farming communities celebrate the richness of life. Occasionally these cycles shape lives and entrench ways of living. When this involves annual outbreaks of disease that wipe out whole flocks of village chickens, poverty becomes entrenched. Farmers learn to keep only a handful of chickens and do not invest in large flocks that could help increase their income. Why bother when the chickens are almost certain to die?

The annual cycle of Newcastle disease outbreaks is an example of how such patterns and cycles entrench poverty. Each September

and October in Singida village in Tanzania, most of the chickens used to die of the disease. In many rural parts of Africa, where native chicken breeds scratch around the village in search of food and water, only the timing of the disease outbreak differs.

Village chickens are at the bottom of the hierarchy of farmed animals. Yet humble village chickens are a crucial building block of the nutritional and economic stability of their owners, usually women. When poor families lose chickens, they also lose the income that pays for food, school fees and medication.

Today in Singida village farmers have large flocks of village chickens. Yet a few years ago

the most anyone kept was five chickens. Most, if not all, the village's chickens died in the annual Newcastle disease outbreaks.

Proceeds from the sale of eggs and chickens help Singida residents such as Paulina Lundry educate her children. Ms Lundry has also exchanged chickens for larger livestock, trading up to goats and now owning three cows. Their sale will help provide money to build a better house.

Her fellow Singida resident Madai Njou now has 150 chickens and a fledgling business selling eggs. Customers come from surrounding villages, helping Mr Njou earn money from the eggs he sells each day.

Many in Singida village now tell similar



PHOTO: BRACKET LIMONAY

Sra Filomena Cuna vaccinating chickens in Mudada Bairro during the July 2005 campaign in Chibuto, Gaza Province, Mozambique.

stories since they began vaccinating their chickens with a simple vaccine developed through ACIAR research.

The origins of the growth in Singida extend back more than a decade. In 1996, veterinarian and infectious diseases expert Dr Robyn Alders moved to Mozambique to work on an ACIAR-funded program to control Newcastle disease.

Newcastle disease can wipe out entire populations of chickens within days, and in the early 1990s a team of scientists led by the University of Queensland's Professor Peter Spradbrow had developed a 'silver bullet' in the developing world's battle with the virus—a vaccine that does not require constant refrigeration. For the ensuing ACIAR project, led by Professor Spradbrow, Dr Alders would oversee a trial rollout of this vaccine in what was then the poorest country in the world.

Over 7 intense years of research design, pre-testing, and supply-chain development—all with rigorous community consultation—she laid the foundation for a sustainable, successful program that has since been applied in other African countries, including Tanzania.

"In all of the trial work we've done there has been 100% protection against virulent strains, provided the bird has received at least the minimum dose to stimulate immunity," says Dr Alders, who received an Order of Australia in 2011 for her contribution to food security in developing countries.

Overall, smallholders in villages with vaccination programs say they enjoy better nutrition through increased protein consumption. The vaccine's indirect benefits of economic stability largely flow through to women, who are the primary stewards of

village chickens. For example, in HIV/AIDS-affected households headed by women, the birds are an ideal income stream as they require little husbandry, seeking their own food and water as required.

Newcastle disease was recognised in 1926 and received its name after an outbreak in England's Newcastle-upon-Tyne. In humans, it can cause minor infections such as conjunctivitis, but for birds the implications are fatal, attacking the gastrointestinal, respiratory or nervous systems. "If the effects are neurological, you'll get birds that have a twisted neck, and locals will say 'they're staring at the stars,'" Dr Alders says. "With virulent strains you can just have birds falling over dead with very few signs except that they're dead."

In many rural areas in Africa 50–80% of birds die each year from Newcastle disease. Farmers split their stocks over several locations to limit the effects of the virus, but will often inadvertently spread the disease when they move infected chickens that have not yet shown signs of illness to the site of a healthy flock.

Farmers re-stock through a system of family networks. They are usually forced to make cuts in other parts of household expenditure, such as medication or schooling, with the education of girls more likely to be discontinued. Importantly, the unpredictable lifespan of chickens due to the presence of Newcastle disease means families often do not eat poultry meat or eggs. Instead they prioritise hatching eggs to get replacement birds that will hopefully be sold for at least \$2 per bird.

"In some places there are taboos that limit egg consumption, and unfortunately it's often pregnant women and young boys for whom

the taboos are in place, because boys are often out tending the herds away from supervision," Dr Alders says.

"Once Newcastle disease is controlled and stock numbers increase, eating eggs is a very good use of resources because you don't have to maintain a larger flock and so don't need to provide additional feed. You just keep a certain number of hens and then start to consume or sell your eggs. So those taboos do change."

The successful Mozambique trial has since been extended into Tanzania, Zambia, Angola, Democratic Republic of the Congo, Ethiopia and Cameroon through projects funded variously by the Australian Government Overseas Aid Program (AusAID), the African Union, the Food and Agriculture Organization of the United Nations and the European Union.

In Mozambique about 20% of villages now vaccinate their chickens, and in Tanzania that number is closer to 40%. The training and implementation manuals developed through the ACIAR work are publicly available to any government wishing to implement vaccination, along with the vaccine's master seed.

#### AN INNOVATIVE PROGRAM

In the history of 20th-century development work, many vaccination programs for humans or animals have failed once funding ends and staff leave. From its outset the goal of this project was to develop a locally run program with villagers managing the knowledge and resources to maintain healthy flocks of chickens.

For Dr Alders, one of greatest assets to the team she brought together for the ACIAR work was social anthropologist Dr Brigitte Bagnol, with whom she had first worked in the early 1990s on an Oxfam project. "I hope to encourage other researchers in my position to recognise the importance of getting a social scientist involved," Dr Alders says. "It not only means that your material is likely to be more effective in the field, but it also opens your eyes to how people think about the process."

Part of the new perspective brought by Dr Bagnol was an understanding of the different interpretations of disease held by villagers, especially where people are not familiar with the germ theory of disease. Many smallholders were also cynical of vaccination due to past experiences in which vaccinators had arrived to treat chickens after an outbreak had already occurred and inoculation was pointless. "The villagers sometimes thought the vaccinator was responsible for the death," Dr Alders says.

One area that especially requires the input of a social scientist is the pre-testing of communication material. "It's particularly crucial for people who haven't been to school, who

aren't particularly literate in two-dimensional images, that sort of thing."

When establishing Newcastle disease control in new areas, the team helps villagers to select vaccinators from among their community members.

"With time it became clear that women frequently turn out to be the best vaccinators because they're much more persistent, they know the households, and they tend not to be as mobile," Dr Alders says. "Sometimes young men will leave the village, going in search of paid employment. Communities, in time, usually start to preferentially select the women."

While the cost of the vaccination was covered by ACIAR during the trial phase, a cost-recovery system is always recommended once national trials have been successfully completed. Therefore in most countries the farmer pays the vaccinator the equivalent of about two Australian cents for both the vaccine and its administration. The vaccinators are also encouraged to regularly consult with farmers to gauge the number of vaccines to order for the next vaccination campaign.

Subsidy models for Newcastle disease vaccination vary from country to country, but Dr Alders believes that cost recovery is the most sustainable, as government funding can unpredictably dry up.

#### LOCAL PRODUCTION AND SUPPLY

Between 1996 and 1998, the ACIAR vaccination project in Mozambique used a vaccine manufactured in Malaysia. But Dr Alders worked to build the capacity for local production in Mozambique of the ACIAR-funded I-2 Newcastle disease vaccine, accompanied by extension material in the local language.

"In most cases we work with government laboratories, and in most cases they are laboratories that have previously produced vaccines and we've helped to recommence production. The basic techniques are quite simple, using embryonating eggs," she says.

Employed by the University of Sydney, Dr Alders is designing two RD&E programs, one with the new Australian International Food Security Centre (AIFSC), which is based within ACIAR. The other, for the African Union, is funded by AusAID and implemented by the Kyeema Foundation—a Brisbane-based NGO of which Dr Alders is a director and which is also home to the International Rural Poultry Centre.

Dr Alders is conducting a scoping study for the AIFSC into the interaction of chickens with other agricultural systems, particularly cropping. As with chickens, crops represent a gender divide, with women in Africa more likely to farm the more nutritious small grains such

as millet and sorghum, while men tend to farm cash crops such as maize. One component of the project looks at ways to integrate chicken husbandry with cropping by using manure to fertilise the soil, and by encouraging chickens to eat postharvest organic litter for dietary enhancement.

Director of the AIFSC Mellissa Wood says the appeal of the poultry project is its direct impact on the livelihood of families. The second part of the project looks at the market-chain effects of improved agricultural practice.

"Now that the flocks are building, there are more opportunities for the smallholders to access markets, and we need to understand what the opportunities are and how these value chains operate," Ms Wood says.

The chicken and crop project will again draw on the expertise of Dr Bagnol and will include other experts such as economists, ecologists and nutritionists.

For the third part of the study, the team will collect empirical data on the impact of Newcastle disease control on human nutrition in Tanzania and Zambia, information that has been largely unavailable.

On a recent visit to Singida village in Tanzania, where vaccination is widespread, Ms Wood witnessed the lifestyle changes and empowerment related to healthy village chickens.

"They're able to purchase food with the proceeds of their chickens, to buy millet to make porridge for the children, they're able to pay education fees," Ms Wood says. "The birds also represent an insurance policy, so if something happens they can sell their chickens and they've got instant cash to deal with it. This gives them resilience, and if they don't have flocks to build up, they're likely to be badly hit by every challenge that comes their way. Newcastle disease control has had a profound impact day-to-day on these farmers."

In Singida, as in many other villages, breaking the annual disease cycle in chickens has created a transformation. Businesses are starting, cooperatives are being formed, more children are being educated. The result is that poverty is no longer the norm and new possibilities are emerging. ■

#### PARTNER COUNTRY MOZAMBIQUE

PROJECT: AS1/96/96 – Investigations into the control of Newcastle disease in village chickens in Mozambique

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Women grinding maize in Limpopo National Park, Gaza Province, Mozambique, in 2009, while village chickens peck through the cobs.





PHOTO: TONY BARTLETT

ACIAR has demonstrated the ability of market-linked agroforestry systems to enhance smallholder farmers' livelihoods, especially when located on sloped and marginal lands. Careful selection of tree species further allows agroforestry to deliver environmental services such as improvement to soils, reductions in soil erosion and improved farming outcomes.

# VIETNAM'S NEED FOR TREES

Australian foresters have drawn on their expertise with fast-growing, resilient Australian tree species to help reforest and rehabilitate denuded landscape in Vietnam, lift smallholders' income and protect remaining natural rainforest. The critical element in the award-winning research for development work was the realisation that trees and rural prosperity are intimately linked.

## KEY POINTS:

- Benefits are flowing directly to smallholder farmers from over 700,000 hectares of *Acacia* trees, which are part of Vietnam's reforestation and plantation forest program.
- Fast-growing species suited to local growing conditions are allowing farmers to supply a thriving timber-processing industry as the trees also provide vital environmental services.
- Genetic material and expertise originating from Australia is helping to drive this progress.

## BY DR GIO BRAIDOTTI

Some people have the idea that deforestation in Vietnam was caused by the use of the herbicide Agent Orange during the US war with the communist Viet Cong in the 1960s and 1970s, or by the ferocious intensity of aerial bombings.

For Stephen Midgley, an Australian expert on the use of Australian tree genetic resources in Asia, while those factors did play a role, by far

the most pervasive cause of deforestation was poverty reducing long-term options.

"I don't think it is right to blame it completely on the Vietnam War. What the war also did was keep people very poor and poor people do desperate things to community assets such as land," he says. "You overgraze it, you cut down trees, you mismanage the land to survive. It is a classic case of the tragedy of the commons in which people overuse natural resources. In Vietnam, by the 1980s, it was

seriously bad in terms of deforestation.”

Of a landmass totalling about 30 million hectares, Vietnam in 1943 had 14.3 million ha of forest; 42% of this area was destroyed in the period to 1995.

“When I first went to Vietnam in 1988, we drove from Ho Chi Minh City to Hanoi several times,” Mr Midgley says. “The drive was characterised by bare hills—lots and lots of denuded hills.”

Since the late 1980s, Vietnam has been implementing a major reforestation program. Australian research has played a small but important role, helping create a new industry along the way. What is astounding about this initiative is that by 2012 Vietnam’s wooded area had increased to 13.7 million ha, remaining native forests had been protected, and tree plantations supply a thriving timber-growing, processing and furniture-export industry that directly benefits once desperately poor smallholder farmers and rural communities.

Vietnamese commitment, skill and entrepreneurship were fundamental to this dramatic turnaround. So too was an Australian export—carefully selected Australian tree species.

Central to Australia’s involvement is CSIRO’s Australian Tree Seed Centre (ATSC) in Canberra, the gene bank that maintains a collection of Australian tree species. It provides seed internationally, in addition to conducting forestry research.

Over the years, CSIRO’s work in Vietnam has been brokered through a number of aid organisations, starting with the United Nation’s World Food Programme and including AusAID. Long-term financial support from ACIAR commenced in 1993, with direct co-investment by CSIRO.

In addition to Mr Midgley, lead roles were taken by CSIRO’s Dr Chris Harwood and Khongsak Pinyopusarerk. Subsequently, Dr Sadanandan Nambiar initiated work on plantation forest sustainability; although currently retired, he continues as a CSIRO Honorary Fellow, assisting Vietnamese colleagues in the use of forestry to reduce poverty. Ten years ago Mr Midgley left CSIRO and is now a forestry-services provider to Asian and Australian forest partnerships.

“Vietnam’s local tree species are, by and large, slow growing and hard to establish on sites that have experienced severe degradation,” Dr Harwood says. “So in the mid-to-late-1980s the Vietnamese were evaluating a range of alternative tree species suitable for producing wood on short rotations on degraded sites.”

Some Australian tree varieties are well known for hardiness, fast growth rates and

ability to tolerate poor soils, making them of interest to the Forest Science Institute of Vietnam.

In Vietnam it was several species of *Acacia*—the genera that supplies Australia with its national floral emblem, the Golden Wattle—that proved especially important.

“*Acacia* wood is suitable for paper production and suitably managed plantations can produce high-quality timber for furniture manufacture,” Dr Harwood says. “While the furniture industry is important to Vietnam—worth more than \$3.9 billion annually—Vietnam imports over three-quarters of the industry’s log requirements. *Acacia* plantations are playing a role replacing some of these imports.”

Today in Vietnam, *Acacia* trees cover an estimated 2% of Vietnam’s land surface. Plantations—about half of them cultivated by smallholder farmers—supply about 10 million green tonnes of wood a year to saw and woodchip mills. In turn, the mills provide employment and business opportunities that further sustain rural development.

All the while the *Acacia* trees are providing vital environmental services, such as preventing soil erosion and providing a stepping stone to rehabilitate land that was formerly native forest.

“As far as Vietnam is concerned, *Acacia* is a very good choice,” Dr Nambiar says. “It is a fantastic pulp tree and increasingly a good furniture timber tree. Unlike eucalypts, *Acacia* provide an important ecosystem service: they fix atmospheric nitrogen and improve soil for the next crop or generation.

“They are relatively easy to cultivate and grow quickly so that smallholders can achieve all these benefits in 6–10 years, throughout

Vietnam’s climate zones, from the tropical south to the subtropical north,” Dr Nambiar says.

“The genetically improved *Acacia* trees are growing in soils where I would have thought few other species would grow properly and that allows the plantations to contribute to the livelihood of rural communities,” he says. “The trees have that kind of versatility.”

When Vietnam started evaluating *Acacia* species it contacted the ATSC to access well-documented seed collections. With about 1,000 *Acacia* species it was important to get the right ones that could sustain scientific tree evaluations and subsequent tree-breeding programs.

“You put in trials to compare different species and within each species you compare provenances, which are different geographical varieties of the species,” Dr Harwood says. “By the early 1990s we knew which would be the best-performing *Acacia* and *Eucalyptus* species in Vietnam.”

The main *Acacia* species selected were *A. auriculiformis* and *A. mangium*. A third species, *A. crassicarpa*, proved suitable for seasonally flooded sites since it has some tolerance to being submerged.

Between 1993 and 2004, ACIAR supported two consecutive projects—‘Seeds of Australian trees’ (SAT) and ‘Domestication of Australian trees’ (DAT)—to help build technical capacity in Vietnam and support the selection and provision of Australian tree germplasm. This enabled the Research Centre for Forest Tree Improvement (RCFTI) to establish broad-based breeding populations and seed orchards of ‘pure’ *Acacia* species (*A. auriculiformis*, *A. mangium* and *A. crassicarpa*) from which to produce improved seed of these species and



Dr Chris Harwood with Pham Xuan Dinh from the Forest Science Institute of Vietnam evaluating sustainable plantation management strategies at an *Acacia* trial at Dong Ha in Central Vietnam.

provide a basis for hybrid breeding, already occurring in Vietnam's acacias.

The dividend today from these efforts is a network of nurseries distributed throughout Vietnam that supply tree growers with elite hybrid planting stock at low cost. Since the trees can be grown on degraded land unsuitable for agriculture, plantation forestry has provided a valuable cash crop for marginal land.

The Vietnamese government has reported average productivity gains for tissue-culture-based *Acacia* plantations of 20–25 extra cubic metres of wood per hectare per year. The faster growth rates mean that hybrids can be harvested 2–3 years earlier than non-hybrids.

*Acacia* plantations also have potential as a nurse crop for Vietnam's native tree species, helping to extend the area covered by native forest.

"There are some big areas in Vietnam where you can see that happening," Mr Midgley says. "You have bare hills and you grow *Acacia* to improve the soil. You then inter-plant native trees so that the *Acacia* trees are providing shade to nurse the native seedlings."

Although *Acacia* were not the only tree type that helped transform Vietnam's denuded hills, they were an especially attractive proposition for farmers with land that is not arable, such as hilly slopes with shallow, rocky and degraded soils. These marginal conditions severely limit smallholders' income from agricultural crops.

After just 5–7 years, it has been estimated that *Acacia* plantations can earn Vietnamese

farmers up to \$2000 from wood sales from 1 hectare of plantation that costs about \$500 to establish and manage.

The Australians all recall witnessing examples of the difference *Acacia* trees made to the livelihood of poor rural communities. They saw farmers who, in just a few years, could afford the purchase of a motorbike, or a small saw miller who sent his son to university, the first from the family to do so.

"Those are sights that really enforce the value of forestry in rural development," Dr Nambiar says. However, he stresses that it does take the right management practices to get the most from tree plantations, shattering the misconception that trees are just "something you stick in the ground" and ignore until harvest.

"That's the erroneous view of forestry," he says. "The plantation has to be managed properly. To achieve good growth rates, you need good-quality seedlings of a suitable species for the location, weed control, nutrition, and you may need to prune heavy branches that otherwise diminish the log's value.

"It is important to understand that a poorly growing or failed plantation serves neither the poor nor the rich; the plantation has to be productive in order to serve society."

The management practices advocated to Vietnamese smallholders are not, however, high technology investments—they are simple ways to maximise income from trees and conserve site resources such as soil for the long term.

Mr Midgley was the first of the CSIRO team

to visit Vietnam and the enabler for ongoing involvement in Asia. Looking back after three decades, the outcome he is most proud of is the estimated \$300–\$400 million going into smallholders' pockets annually because of innovations to forestry.

The results were published in 2007 in an ACIAR Impact Assessment Series report (No. 47), *Improved Australian tree species for Vietnam*.

Total ACIAR investment in the projects amounted to nearly \$6 million, with a further \$3.9 million from CSIRO Forestry and Forest Products as in-kind contributions and a further \$164,000 contributed by Vietnamese collaborators. The internal rate of return on the projects was estimated to be about 32%. Assuming a discount rate of 5%, the net present value of the project was about A\$129 million, implying a benefit:cost ratio of 79:1.

"The whole thing has to be run by improving people's livelihoods," Mr Midgley says. "It is because livelihoods have been improved that people have been encouraged to plant trees. One keeps reinforcing the other. It has to be market-linked—it is the demand for wood that drives it." ■

#### PARTNER COUNTRY VIETNAM

PROJECT 1: FST/1993/118 – Seeds of  
Australian trees

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## The secret of forestry's poverty-reducing prowess

While the standard of living is improving rapidly for most of Vietnam's 85 million people, about 10% of the population still live in extreme poverty. Incomes are especially low in mountainous rural areas in Vietnam's north-west provinces where subsistence agriculture and unsustainable land use practices prevail in ways that trap farmers in poverty.

The north-west provinces are home to ethnic minorities such as the Hmong people, who farm the steep slopes to produce maize and upland rice. These practices lead to substantial loss of soil and sedimentation of reservoirs used for the production of hydro-electricity.

These rural areas need income-earning alternatives and ACIAR is testing the ability of market-linked agroforestry systems to enhance livelihoods, improve soils, reduce erosion and improve farming outcomes.

Dr Sadanandan Nambiar says that despite trees needing time to reach harvest, forestry has an important role to play in reducing rural poverty and *Acacia* plantations provide opportunities even where soils are poor and eroded. The critical element is to select and breed the right tree species, while developing suitable and sustainable management practices on

behalf of farmers.

"Say a farmer grows small blocks of *Acacia*, he can thin out some trees and sell those small, low-quality trees for pulp and make some money," he says. "He can cultivate higher-quality logs. He can then look after the remaining trees and increase the plantation's value considerably."

There can be a 10-fold difference in income between selling crooked, twisted trees for chipping compared to well-managed, tall, straight trees for sawing. That means production can be phased to provide cycles of income and overlapping income-generating strategies.



Dr Sadanandan Nambiar (right) discusses soil development at an *Acacia* trial at Dong Ha in Central Vietnam.



# Tiny black insect threat to Bhutan citrus

An ACIAR project is helping Bhutan protect one of the kingdom's most important cash crops, mandarins, from the insects that spread a devastating disease.

The citrus psyllids can harbour bacteria that cause a devastating citrus disease.

PHOTO: ANDREW BEATTIE

## KEY POINTS:

- Researchers in Bhutan have discovered that a black psyllid can harbour the bacteria that cause huanglongbing, a devastating citrus disease.
- Research on whether the black psyllid can transmit the disease to healthy plants plus programs to combat citrus pests and diseases in Bhutan will benefit Australian biosecurity.
- The research forms part of a renewed ACIAR program to assist Bhutan develop an integrated citrus crop management strategy and commercialise mandarin production.

BY LINDA VERGNANI

**A**t the University of Western Sydney, entomologist Professor Andrew Beattie and plant pathologist Namgay Om study a photograph of a “beautiful” creature that was recently found to harbour the lethal citrus disease, huanglongbing (HLB).

It is a black psyllid, *Diaphorina communis*, tiny as a dried tea-leaf. Photographed in Bhutan, the sap-sucker feeds in a headstand position, its

legs tucked against its body like the spokes of a folded umbrella.

The scientists were among a team of Australian and Bhutanese researchers who tested black psyllid adults for HLB bacteria, after spotting the insects on diseased mandarin trees in Bhutan. Their findings proved that the black psyllid can harbour the Asiatic form of HLB bacteria, *Candidatus Liberibacter asiaticus*.

HLB has devastated citrus crops in Bhutan and surrounding South-East Asian nations, as well as in numerous other countries including Saudi Arabia, South Africa, Brazil and parts of the US. The disease is spread by psyllid insect vectors, which transport the pathogen from infected plants to healthy plants as they feed. So far only the Asian citrus psyllid, *D. citri*, and the African citrus psyllid, *Trioza erytreae*, have been proven to transmit HLB.

With 40% of Bhutan's population dependent on mandarins for food and income, ACIAR is now funding research to determine if infected black psyllids can transmit the disease.

HLB, which translates as ‘yellow dragon disease’ or ‘yellow shoot disease’ in Chinese,

can kill young citrus trees in 3–5 years. In some areas, the majority of trees die before they have a chance to mature and produce fruit. Among early symptoms of the disease are yellow mottled leaves, while later the plant produces small, lopsided, bitter fruits of little commercial value.

Ms Om has come to Sydney on a 4-year ACIAR John Allwright Fellowship to do her doctoral research on whether the black psyllid can transmit HLB to other citrus plants. Deputy chief plant protection officer at the National Plant Protection Centre in the Bhutanese capital Thimphu, Ms Om performed molecular tests in Bhutan that proved the black psyllid can harbour the disease. Further tests in Australia confirmed these results.

“We established the laboratory in Thimphu in 2006 specifically to test for HLB in the country,” she says. “We’d seen these insects before, but never thought of testing them.”

If the new research proves that the black psyllid is a vector for HLB, then Bhutan will have to amend its pest-control strategies and Australia will need to tighten biosecurity to stop

PHOTO: LINDA VERGNANI



Bhutanese plant pathologist Namgay Om discusses citrus disease with Andrew Beattie, Professor of Agricultural Entomology in an orchard at the University of Western Sydney.

these insects from entering the country.

"There's no way that Bhutanese can do these things on our own," Ms Om says. "We don't have the technical expertise, so it's a big opportunity. I really love this work."

The black psyllid research is part of a broader ACIAR-funded project that aims to improve citrus production in Bhutan through capacity building and integrated crop management techniques. Les Baxter, ACIAR's research program manager for horticulture, says the Bhutanese Government is excited by the program and "they are exemplary to work for".

"In Bhutan, citrus is the biggest game in town for the horticultural sector," he says. "People can grow a relatively small number of trees, but make enough money to send their kids to school, buy medicine and stuff like that. This is quite important for small and medium farmers."

About 65% of Bhutan's citrus crop is grown in backyards or smallholdings, with farmers relying on a single mandarin cultivar and growing virtually all trees from seed.

The Bhutanese Department of Agriculture has an ambitious Citrus Master Plan, which aims to commercialise citrus production and quadruple mandarin exports from the current 22,000 tonnes a year (half the total annual citrus

production in the country) to 100,000 tonnes within 5 years. HLB is a major constraint to reaching this target.

In the first phase of the ACIAR program, started in 2007, experts supported Bhutan's national citrus development program through activities such as trialling a sustainable pest-management program. Senior Bhutanese citrus officials and extension officers visited Australia to learn about better citrus management practices and in turn trained about 250 farmers. (See 'Sharing our citrus success with Bhutan', *Partners*, June–August 2011.)

Now the program has been allocated an extra \$1.16 million and extended to 2017. A major focus will be on improving Bhutan's citrus orchard management practices, including identifying the best local cultivars of mandarin and other wild citrus species and establishing a national mother tree germplasm repository in an insect-proof enclosure. This will provide Bhutan with a source of clean citrus germplasm and rootstock seed from which healthy nursery trees can be produced.

Grafted trees can fruit within 3 years, as compared with 7–9 years with seedling stock, so more farmers will be able to harvest mandarins before their trees are killed by HLB.

As part of the program, postdoctoral and

PHOTO: DORJEE



Australian project leader Sandra Hardy checking curry plants by the roadside for psyllids on a trip to Bhutan in September 2012.

doctoral students, such as Ms Om, are being brought to Australia to do research. Bhutanese agricultural extension officers will come to Australia to work at commercial facilities and nurseries, where they can learn skills including canopy management and propagation.

The ACIAR project is led by Sandra Hardy, citrus industry leader for the New South Wales Department of Primary Industries (DPI), in collaboration with Mr Dorjee, national citrus coordinator with the Bhutan Department of Agriculture.

Ms Hardy describes Bhutan as "an amazing country". The ACIAR project had to get approval from the Gross National Happiness Centre, as any development project in Bhutan has to benefit the people and improve their wellbeing.

Australian scientists and citrus industry experts visit Bhutan for 2-week stints. Ms Hardy says that because it is so mountainous, it can take 7 hours to travel 150 kilometres. But their job is easy compared to Bhutanese extension officers, who have to walk for up to 5 days to reach farmers in remote areas.

"The aim of the project is to ensure that Bhutanese farmers are aware of the main pests and diseases and the management strategies to control them and improve production," she says. "At the moment, there is a lot of disbelief



PHOTO: SANDRA HARDY



A typical mandarin orchard in eastern Bhutan. This orchard is one of the sites where local Department of Agriculture staff are showcasing improved management practices such as basin making and pruning to the farmers in the local area.

from farmers that a citrus disease can be transmitted by insects. They are going to have to learn to recognise the symptoms of the disease and what steps can be taken to reduce its impact.”

Since Bhutan prefers an organic approach to farming, Ms Hardy says the Australians are demonstrating more natural disease-control measures, such as using mineral oil sprays for pest control and sulfur sprays for controlling powdery mildew. She says a key strategy to help combat HLB is to remove all diseased host plants.

By introducing the use of rootstocks and raising healthy nursery trees, the project is giving farmers a better chance of producing fruit within a shorter timeframe. Ms Hardy says the Bhutanese Government will probably have to initially subsidise the cost of healthy replacement trees to encourage farmers to remove diseased plants.

Among Australian benefits from the project is that NSW DPI officers will be able to improve field recognition and laboratory diagnostic tests that could help detect exotic citrus pests and diseases and prevent them from entering Australia. The project also includes research on evaluating potential new rootstocks for mandarins and citrus varieties for the Australian

citrus industry.

Ms Hardy warns that if the disease and its psyllid vectors enter Australia, it could increase production costs by up to 40% and devastate Australia’s citrus industry.

Professor Beattie says a complicating factor is that plants such as orange jasmine, *Murraya exotica*, a widely cultivated ornamental, can be infected with HLB. In Bhutan, the researchers found the black psyllid’s favourite food was the curry leaf plant, *Bergera koenigii*, a citrus relative that may host the disease. So the ACIAR researchers will test curry leaf plants to see if they can also be infected with HLB.

If curry leaf is a host of the disease, it will make control in Bhutan more difficult and will also mean Australian authorities need to be more vigilant about illegal imports of fresh leaves of this popular plant for cooking. Professor Beattie says Australian quarantine authorities recently intercepted and destroyed black psyllid adults on fresh curry leaves imported from Sri Lanka.

He cites Florida’s experience of HLB disease as a cautionary tale for Australia. When the Asian citrus psyllid was first found in Florida, in the US, in 1998, the authorities failed to take precautions to eradicate the pest. It was not until 2005 that HLB was first discovered in Florida and by 2008,

citrus greening had spread to virtually all citrus-producing counties in the state.

Professor Beattie says in some countries, infected citrus plants have been smuggled in by commercial growers “who should know better”.

Provided curry leaf plants are ruled out as a host, Professor Beattie suggests the Bhutanese authorities could eradicate all citrus trees in certain isolated valleys surrounded by high mountains. With no host citrus plants, the infected psyllids would die out and the mountainous terrain would be a natural barrier to stop new ones flying in.

After a few years, smallholdings could be replanted with disease-free, grafted mandarins that were raised in insect-proof facilities. This would mean a possible clean start for local citrus farmers. ■

#### PARTNER COUNTRY BHUTAN

**PROJECT: HORT/2005/142 – Improving mandarin production in Bhutan and Australia through the implementation of on-farm best management practice**

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# Climate-smart agriculture: a food policy perspective



PHOTOS: BRAD COLLIS

BY PROFESSOR PETER TIMMER



In the past few years there has been renewed emphasis on the challenge of achieving food security for all. Policy initiatives that

build on the theme of flexibility in coping with market instability, first introduced in *Food Policy Analysis* (Timmer CP, Falcon W & Pearson S, The World Bank, 1983), are an important element in meeting that challenge.

A second challenge has also received significant emphasis over the past decade—that of climate change. The challenge with climate change is not so much at the level of market interactions, although increased trade will also be an important part of the response, but rather that climate change challenges the very foundations of agriculture: climate-based ecosystem services essential for sustainable production.

Especially in Asia, domestic policy initiatives have worked reasonably well at the market level to significantly enhance market stability and food prices. However, the same policy levers are likely to be less effective in mitigating climate change. Most climate experts feel that effective mitigation will require binding global agreements on greenhouse gas emissions, and few countries will have sufficient incentives to carry out mitigation policies domestically (China, India and Indonesia may be exceptions).

The key to improving food security going forward, then, will be in the design and implementation of adaptation strategies, as farmers learn to cope with a warmer and more volatile world.

As the recent food price crisis of 2007–08 demonstrated, pressures on agricultural production are mounting and impinging on policy options and payoffs. At the heart of policy design in *Food Policy Analysis* is the

ambitious goal of rapid and sustained poverty reduction. To achieve this goal, four basic food policy objectives were proposed:

- 1 Faster economic growth (the 'efficiency' objective).
- 2 More equal distribution of income from that growth (the 'welfare' objective).
- 3 A guaranteed nutritional floor for the poor (the 'safety net' objective).
- 4 Secure availability and stable prices in food markets (the 'food security' objective).

Achieving the overall goal of rapid poverty reduction through policy interventions involves trade-offs and overlap among these four objectives. These trade-offs imply that a solely market-based solution for food prices will not work, hence the need for policy interventions that operate compatibly with each other and with market prices.

The explicit intent of this approach is to link the macro-food system—the economy-wide market outcomes involving food and agriculture—with an understanding of the behaviours of decision-makers based throughout that system, from farmers to consumers (and even to finance ministers) and all those in between. These behaviours are set by, and elicit responses to, the signals sent on food pricing to all the players in the system.

For a period from the early 1980s, when *Food Policy Analysis* was first published, until the mid-2000s world food prices declined. The consequence was a decline in investment, with governments, donors and research institutions reducing the amount spent on the food and agriculture sectors. That decline in investment had an inevitable effect, as productivity growth fell and food security became more tenuous for many of the poor. The food price crisis of 2007–08 was the result.

## THE INTERNATIONAL CONTEXT

Broader changes have also taken place since *Food Policy Analysis* was first published in 1983. In particular, the international context has changed quite substantially:

- rapid economic growth, especially in Asia, has lifted hundreds of millions of people out of poverty, creating an emerging middle class;
- a communications revolution at both the household and international levels has radically reduced transactions costs, leading to tighter market integration and increased access to knowledge;
- global financial markets became interested in emerging economies, with quite unforeseen consequences for financial stability;
- the rapid emergence in the 1990s of China and India as global growth engines meant a gradual shift in the drivers of demand for commodities and natural resources from slow-growing rich countries to the rapidly growing emerging economies;
- high energy prices have turned out to be a 'game changer' for agriculture and the food economy by linking energy prices with the prices of basic staple foods that can be converted into liquid fuels; and
- climate change is imposing itself as a reality on the increased probability of extreme weather events in general, but also on both global and localised food security outcomes.

These changes have shifted the landscape in terms of policy initiatives in agricultural production, marketing and consumer interventions as a means to encouraging rapid poverty reduction. The resulting global food price regime presents more uncertainty in relation to the best approaches to food pricing policy and the transformations needed to reduce poverty.

Historically, the pathway of structural transformation in developing countries has

seen falling food prices, aligned with a falling share of agriculture in economic output and employment. This is achieved through a migration of rural workers to urban areas and a rising share of urban economic activity (industry and services) contributing to economic growth. During this transition a population spurt is experienced, before a new equilibrium is reached.

The policy challenge in this context has been to deliver mechanisms that point the poor to the pathway towards growth, or to prevent the poor from falling from that pathway. This is underpinned by policy that supports the necessary rising productivity in agricultural and non-agricultural sectors that drives economic growth.

During this transition, food policy interventions are important to keeping staple foods accessible to the poor, connecting rural labour to urban employment and delivering health and education services, particularly in rural areas experiencing a rapid transformation.

The key to this transformation is supportive policy settings that encourage investment in appropriate areas, such as boosting agricultural productivity, and encourage broader growth throughout the national economy, especially growth that will absorb surplus labour from rural areas at higher productivity than it can achieve in agriculture.

### A NEW SCENARIO

This historical pathway to transformation is not a certainty in the changing global context. The potential is for climate change and associated responses, notably the growth in biofuels, to reverse the long-term trend in declining commodity prices. This would also reverse the higher incomes resulting from the historical pathway of transformation, outlined above.

As climate change has gradually increased

impact, higher temperatures and greater variability of rainfall are anticipated. These will inevitably impact on agricultural sectors in a number of ways, including:

- constant changes in climate-based ecosystem services;
- increased variability of seasonal products;
- shifting areas of land use and new areas of marginal production;
- higher and more volatile commodity prices driven by variable supply and yield pressures from changing climates; and
- greater impacts on the poorest producers, leading to increased pressures on the poorest households in terms of income generation and food security.

A second factor in this scenario, already beginning to take effect, is the growing demand for biofuels, driven by efforts to mitigate the causes of climate change. The likelihood of increasing demand, driven by rising middle classes increasingly using private transport, is increased investment in the biofuels sector. Higher grain prices will require subsidies to deliver a profitable biofuels sector. The result is likely to be a willingness on the part of governments, especially governments in rich countries, to subsidise this sector, keeping prices high, a scenario agreed by most observers of the sector.

If these scenarios play out, what are the consequences for economic growth and poverty reductions in developing countries? Not surprisingly, the answer depends on the role of agriculture in individual countries.

If only large farmers are able to reap the benefits of higher grain prices, and their profits do not stimulate a dynamic rural economy, a downward spiral can start for the poor. High food prices cut their food intake, children are sent to work instead of school and an intergenerational poverty trap develops.

If the poor are numerous enough, the entire economy is threatened, and the structural transformation comes to a halt. The share of agriculture in both employment and GDP starts to rise, and this reversal condemns future generations to lower living standards. There will be much more 'structural' poverty, and countries determined to cope with it will find themselves supporting expensive and long-term safety nets for the poor.

A reversal of the structural transformation as the regular path to economic development and reduced poverty will be a historical event, countering the patterns generated by market forces over the past several centuries. Such an event is likely to have stark political consequences, as populations do not face the sustained prospect of lower living standards with equanimity. It is possible, of course, that new technologies will come on-stream to lower energy costs across the board and thus allow the biofuel dilemma to disappear quietly. But the current prognosis is that it will not be this easy.

The consequences of such a reversal will require new ways of thinking. Longer term, rising commodity prices may create an incentive for agricultural production, assuming that the impacts of climate change are managed and do not reduce yields by too much on average.

To bring this about will require a reinvestment in agriculture, both in research and in rural infrastructure across the sector in developing countries. Coping with climate change also poses questions for smallholder farmers and what policies will be needed to ensure that they have a future in this scenario.

Going forward, the challenge of food security for all is directly tied to the management of climate change. Lobell and Burke make the following observation:

*"...one thing appears almost certainly true in the twenty-first century; if agriculture and food security are to thrive, they will have to do so in a constantly warming world. The level of climate stability that has been experienced since the dawn of agriculture is a thing of the past; the future will be one of constant change. This need not spell disaster for food security, but we would be wise not to underestimate the enormity of the challenge at hand."*

[Lobell D. and Burke M. (eds) 2010. *Climate Change and Food Security: Adapting Agriculture to a Warmer World. Advances in Global Change Research*, Vol. 37, p1960]

Food policy analysis that understands this challenge and offers insights into how best to cope with it will be a key driver of how successfully society adapts to climate change. ■

### About the author

**Peter Timmer is adjunct professor at the Crawford School of Public Policy at ANU. Now retired from teaching, he is the Thomas D. Cabot Professor of Development Studies, emeritus, at Harvard University. Prior to joining CGD, Professor Timmer was dean of the Graduate School of International Relations and Pacific Studies at the University of California San Diego. In addition to his faculty positions in three schools at Harvard, Professor Timmer has also held professorships at Cornell and Stanford. In 1992, he received the Bintang Jasa Utama (Highest Merit Star) from the Republic of Indonesia for his contributions to food security. He served as the chief outside adviser to USAID for developing their strategy on growth and agriculture for the Natsios Report (*Foreign Assistance in the National Interest*), and he was one of the key advisers for the *World Development Report 2008: Agriculture for Development*. He currently serves as an adviser to the Bill and Melinda Gates Foundation on agricultural development and food security issues.**

**Professor Timmer's work focuses on four broad topics: the nature of 'pro-poor growth' and its application in Indonesia and other countries in Asia; the supermarket revolution in developing countries and its impact on the poor (both producers and consumers); the structural transformation in historical perspective as a framework for understanding the political economy of agricultural policy; and the functioning of the world rice market.**

## EXTERNAL REVIEW OF ACIAR

Over the past five years Australia's aid program has grown in size in line with the Government's commitment to ensure Australia is contributing 0.5% of gross national income to aid initiatives. During that time ACIAR has also grown, doubling in size over recent years, with an annual appropriation of approximately \$100 million in 2012-13.

The 2011 review of the Australian aid program as a whole found ACIAR produced "impressive results, confirmed by independent evaluations". The most recent meta-analysis of 130 ACIAR projects has demonstrated estimated total benefits of \$31.6 billion, with \$29.4 billion of these benefits flowing directly to developing countries.

One of the key tenets of the review of the total aid program was the need to ensure efficiency and effectiveness of delivery. The Australian Government, Parliament and taxpayers need to be confident that current and further investments are targeted appropriately, are effective in helping overcoming poverty and are used efficiently.

To this end, the Australian Government commissioned a review of ACIAR in the second half of 2012. Announcing the review the Foreign Minister, Senator Bob Carr, reiterated the importance of agricultural research in reducing poverty.

"Five-hundred million people living in poverty rely on farming, trying to grow enough food for themselves and their families on areas as small as the size of an Australian suburban backyard," Senator Carr said.

"Improving agricultural productivity is essential to these smallholders achieving food security, overcoming poverty and building resilience to alleviate the impacts of climate change and famine.

"The 2011 independent

aid review and the Australian Government's response highlighted the need to continue to deploy Australian research expertise in agriculture, as part of the aid program."

Senator Carr said the recommendations from the ACIAR review would improve the Australian Government's contribution to global food security through international agricultural research.

This is the first independent public review of ACIAR since the Nairn Review in 1998, and comes as ACIAR enters its fourth decade of operation. The review recognises the Comprehensive Aid Policy Framework and the significant changes occurring in Australia's aid program and in the programs and priorities of ACIAR's partners around the world. The report will underpin a new Strategic Plan for ACIAR to 2015-16.

Within the context of ACIAR's enabling legislation, the review has focused on:

- the appropriateness of ACIAR's goals and strategies in supporting the fundamental purpose of Australian aid, that is, helping people overcome poverty;
- ACIAR's effectiveness in improving livelihoods through more-productive and sustainable agriculture, and in achieving intermediate knowledge generation and capacity-building outcomes; and
- the efficiency of ACIAR's operations and arrangements for managing research programs and building capacity, including internal capability and systems, risk management, performance oversight and transparency.

The review panel, comprising Mr Bill Farmer (Chair), Professor Ron Duncan, Dr Wendy Jarvie and Mr Terry Enright, is in the final stages of preparing its report and recommendations to Government.

## NEW STAFF

**Ms Liz Ogutu – liaison officer, Australian International Food Security Centre (AIFSC).**

**Liz holds a BSc and Postgraduate Diploma in Information Technology from the Open University (UK) and a Diploma in Computer Systems Design. She also holds an MBA from the Edinburgh Business School, Heriot Watt University. She has spent the past 5 years at the International Livestock Research Institute as the resource mobilisation officer in charge of fundraising activities and relationship management. She joins the AIFSC on secondment from ILRI.**

**Ms Chunyan Jia – Horticulture Program support officer. Chunyan has a diverse background in administrative support and holds a masters in international law from Renmin University in Beijing.**

**Ms Lisa Port – Fisheries Program support officer. Lisa is currently studying for a Bachelor of Science (Environment and Sustainability) at the University of Southern Queensland. Lisa has held a number of administrative positions with private and public-sector organisations. Her last role was with the Department of Agriculture, Fisheries and Foetry as a project support officer and executive assistant.**

**Ms Luisa Schiavello – finance and payroll officer. Luisa has a diverse work history in finance, payroll and administration roles across private and public organisations. She holds a Bachelor of Commerce (Accounting) and comes to ACIAR after working at the National Archives in the payroll section.**

## NEW PROJECTS

AGB/2012/009	Eastern Indonesia agribusiness development opportunities: analysis of vegetable value chains
CIM/2011/026	Sustainable wheat and maize production in Afghanistan
FIS/2011/052	Improving research and development of Myanmar's inland and coastal fisheries
FST/2008/039	Enhancement of production of acacia and eucalypt peeled and sliced veneer products in Vietnam and Australia
HORT/2012/104	Tropical exotic fruit research and development needs in the Philippines and northern Australia
LPS/2010/010	Competitive smallholder livestock in Botswana
LWR/2010/081	Enhancing the resilience and productivity of rainfed-dominated systems in Lao PDR through sustainable groundwater use
LWR/2011/045	Management of water and salinity in the Nile Delta: a cross-scale integrated analysis of efficiency and equity issues
PC/2011/053	Identifying appropriate strategies for reducing virus and weevil losses in sweetpotato production systems in PNG and Australia
PC/2012/011	Understanding the responses of taro and cassava to climate change
SMCN/2011/046	Diversification and intensification of rice-based systems in lower Myanmar

## ROUNDUP

To keep up to date with the latest events, projects and happenings at ACIAR please visit our website ([aciarc.gov.au](http://aciarc.gov.au)), our blog ([aciarcblog.blogspot.com.au](http://aciarcblog.blogspot.com.au)) or on Twitter ([twitter.com/ACIARAustralia](http://twitter.com/ACIARAustralia)). You can also subscribe to our RSS feed ([aciarc.gov.au/RSSfeeds](http://aciarc.gov.au/RSSfeeds)) to get updates on the latest happenings at ACIAR.

## NEW PUBLICATIONS

### CORPORATE PUBLICATIONS

#### ACIAR Annual Report 2011–12

ACIAR, 2012, 194pp

Contact ACIAR for hard copies

ACIAR's Annual Report for 2011–12 outlines the centre's research and financial performance during the past financial year. The report has been prepared in accordance with the relevant sections of the *ACIAR Act 1982* and the *Financial Management and Accountability Act 1997*, and meets all reporting requirements, as well as ACIAR's performance against its 2011–12 Annual Operational Plan.

### TECHNICAL REPORTS



#### Food security in East Timor, Papua New Guinea and Pacific island countries and territories

Debbie Templeton (ed.),

2012, TR080, 53pp. \$33 inc. GST

Research funded by ACIAR is largely directed towards attaining food security. This report documents the food security issues in three of ACIAR's focus areas: East Timor, Papua New Guinea and the Pacific islands. The studies help identify which problems are amenable to solutions through research, development and extension.



#### Enhancing livelihoods in Lao PDR through environmental services and planted-timber products

Stephen Midgley, Jeff

Bennett, Xeme Samonty, Peter Stevens, Khamphone Mounlamai, Dao Midgley and Alan Brown, 2012, TR081, 100pp. \$39 inc. GST, MN 87 2nd ed.

This report provides a thorough exploration of the concept of payments for environmental services (financial benefits to land managers who, through improved practices, enhance environmental services such as carbon sequestration, protection of water quality and biodiversity conservation) and the value chains for wood products in Lao PDR. Both these topics are intrinsically linked by their focus on the forests of Laos and their aim of improving livelihoods for thousands of Lao people, many of whom live below the poverty line. The report recommends researchable issues and how these could be tackled.

### IMPACT ASSESSMENT SERIES



#### Including natural resource management and environmental impacts within impact assessment studies: methodological issues

David Pearce and Lauren White, 2012, IAS081, 52pp. \$42 inc. GST

This report provides an overview of the methodological issues involved in incorporating environmental and natural resource values within ACIAR's economic impact assessments. Recent developments in analytical techniques have provided a sound basis for combining two parallel streams of research: traditional economic analysis of the environment and the 'ecosystem service' approach to evaluation. These approaches are complementary, and they bring an added dimension to measuring the benefits attributed to ACIAR-funded research.



#### ACIAR's activities in Africa: a review

Hayden Fisher and Laura Hohnen, 2012, IAS082, 80pp. \$32 inc. GST

ACIAR has a long history of working with countries in Africa. Given the increasing attention to food security in Africa—leading to the establishment of ACIAR's Australian International Food Security Centre—it is timely to review ACIAR's experiences in Africa to date. Reviewing past projects can help guide future investment decisions by highlighting the types of projects that deliver the best returns and by identifying some of the barriers faced in different countries.

### MONOGRAPHS



#### Controlling Newcastle disease in village chickens: a laboratory manual – 2nd edition, English and French versions

Mary Young, Robyn Alders, Sally Grimes, Peter Spradbrow, Paula Dias, Amílcar da Silva and Quintino Lobo, 2012, MN087 2nd ed and MN087a 2nd ed, 143pp. \$66 inc. GST

This manual, originally published in 2002, describes the procedures needed to produce and test live, thermostable, avirulent I-2 vaccine against Newcastle disease (ND) of poultry. It has formed the basis for practical training workshops for scientists and technicians in vaccine-producing laboratories in Africa and Asia. This second edition, updated on the basis of practical experience over the past decade, has been published due to increasing interest in local production of ND vaccine. The French translation will also ensure this information is readily accessible to francophone countries in the region.



#### Vanuatu sandalwood: growers' guide for sandalwood production in Vanuatu

Tony Page, Hanington Tate, Joseph Tungon,

Michael Tabi and Phyllis Kamasteia, 2012, MN151, 56pp. \$25 inc GST

ACIAR has supported research into the growing and marketing of sandalwood in Vanuatu. This guide provides practical advice on how to grow sandalwood, including site and host selection, spacing, weeding, disease management, pruning and harvesting. Sandalwood's high value and small size make it unique among forestry trees in that it can be incorporated into smaller ornamental gardens as well as larger commercial plantings. This guide will help the people of Vanuatu and other Pacific island countries to participate in this lucrative rural industry.



#### Sophy and the vegetable patch

ACIAR and MJP, MN152 and MN152a (Khmer translation), 2012, 44pp.

\$22 inc GST

This book is for primary school children for use in the 'Life Skills' part of the Cambodian school curriculum. It will teach children and their families about human nutritional needs, how these can be met through eating indigenous vegetables, and how to create their own garden so that they can grow their own healthy food year round.

### FINAL REPORTS (AVAILABLE ONLINE ONLY)

FR2012-21 to FR2012-31

## ACIAR'S DISTRIBUTION POLICY

ACIAR provides complimentary copies of its publications to developing-country libraries, institutions, researchers and administrators with involvement in agriculture in developing countries in ACIAR's operating areas, and to scientists involved in ACIAR projects. For enquiries about complimentary copies, please contact ACIAR's Communications Unit, [comms@aciarc.gov.au](mailto:comms@aciarc.gov.au).

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