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IN RESEARCH FOR DEVELOPMENT

BIOSECURITY

AVIAN INFLUENZA
PIG VIRUSES
EUCALYPT RUST
POTATO LATE BLIGHT
BANANA WILT DISEASES

ACIAR tackles pests and diseases

Research into disease and pest management is crucial for reducing poverty and providing food security in developing countries. An important subset of this research is concerned with *containment* of pests and diseases—otherwise known as biosecurity. It involves the development of policies and mechanisms to stop pests and diseases spreading within a region, or from one region into another.

Pests and diseases have no respect for national boundaries, and in today's increasingly inter-connected world, the movement of unwanted organisms is not difficult. Trade is a common way to introduce pests and disease. With animals it is through the marketing of stock; with plants it is through accidental import (on the bottom of shoes, tyres, etc) and poorly regulated trade. However, to gain access to markets countries must prove themselves free of pests and disease.

The principal purpose of all ACIAR-funded biosecurity projects is to secure farmers' livelihoods by finding solutions to the problems in the partner countries, and to enable these countries to become participants in the international trading community. However, there is a legitimate spin-off from this type of research, which is in line with one of Australia's national research priorities, that is, protecting Australia from invasive diseases and pests. By studying a biosecurity problem in-country, Australia is well placed to attack the problem should it reach our shores and, better still, to prevent it from reaching here in the first place.

Most of our biosecurity projects involve collaboration with our most immediate neighbours—Papua New Guinea, Indonesia and Pacific island countries. The closer a country is, the greater the chance of pest and disease spread. Although collaboration provides mutual benefits, Australia has an important self-interest in helping regional countries on biosecurity matters, driven largely by a desire to facilitate trade. So by helping our partner countries, we are also helping ourselves. The late Professor Derek Tribe, who was instrumental in the establishment of ACIAR, summed this up eloquently in the title of his 1991 book *Doing Well by Doing Good*.

In this issue of *Partners* we provide a small sample of the collaborative biosecurity research that ACIAR has funded. This includes projects on animal health (avian influenza, classical swine fever, foot-and-mouth disease, disease surveillance), forestry (guava rust of eucalypts), crop protection (banana wilt diseases and potato late blight) and fisheries (shrimp diseases). And our profile this issue is a man with a passion for agricultural research and biosecurity—Dr Luis Rey Velasco, newly appointed chancellor of the University of the Philippines, Los Baños campus.

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Partners in Research for Development is the flagship publication of the Australian Centre for International Agricultural Research (ACIAR). ***Partners*** presents articles that summarise results from ACIAR-sponsored research projects, and puts ACIAR research initiatives into perspective.

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Features

Profile

ACIAR roundup

Broilers almost ready for market in an intensive broiler farm owned by a family in Lombok.

Understanding BIRD FLU

Avian influenza is not only a threat to human lives, it has also caused serious harm to South-East Asia's tourism and poultry industries. ACIAR projects are helping to mount a strong response

BY KAREN McGHEE

When Bali was hit for the first time by an outbreak of the deadly H5N1 bird flu strain, the local economy was still reeling from the impact of bombings in the island's Kuta nightclub and restaurant precinct. It was late 2003 and another crushing blow for local tourism, Bali's main industry.

Officially, there have been no human deaths in Bali caused by bird flu—also known as avian influenza (AI). But the threat is enough to create panic whenever and wherever the disease appears.

"AI outbreaks get heavily reported in the press and the demand for chicken goes right down, which causes hardship for farmers and anyone else dependent on the local poultry industry," explains University of New England (UNE) economist Dr Phil Simmons, who recently began an ACIAR project to assess AI's impact on poverty in Indonesia. "But there's also an awful lot of concern about the wider potential flow-ons to tourism. Bali's tourist industry is probably now operating at about 40% capacity [due to bombings in 2002 and 2005] and the last thing they need are more fears about AI."

In March 2007, Bali had just experienced its fourth outbreak. But the preliminary results of Dr Simmons's surveys on the island indicate the disease claimed about half the chickens it did during earlier outbreaks.

"It suggests that farmers are responding better and implementing biosecurity measures, which they haven't done before," says Dr Simmons. "We're also seeing a lot more vaccinating of chickens, so that may have also been significant."

The project is being managed in Indonesia by another UNE researcher, Dr Budi Santosa, who has helped recruit and train a local team of agriculturalists—mostly extension officers—from Indonesia's Ministry of Agriculture to conduct the surveys. So far, raw data have been gathered from 200 households in Bali and 200 on the nearby island of Lombok. The project will run for at least another two years.

Like everywhere that has experienced AI outbreaks, exactly what is happening with the H5N1 strain in Bali and elsewhere in Indonesia is unclear. However, these are early days in the history of the disease. As hundreds of millions of dollars worldwide are poured into researching

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PHOTO: PHIL SIMMONS

PARTNER COUNTRIES: Indonesia, Vietnam

PROJECTS: AH/2004/040: The epidemiology, pathogenesis and control of highly pathogenic avian influenza in ducks in Indonesia and Vietnam; AH/2005/032: Identification of policy responses to minimise negative socioeconomic impacts of an avian influenza epidemic in Indonesia; AH/2006/050: Control and characterisation of highly pathogenic avian influenza strains in poultry in Indonesia; AH/2006/164: Future directions for animal health services in Indonesia

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PHOTOS: PHIL SIMMONS

Collecting and unloading broilers produced under contract for wet markets (where birds are sold live) in Mataram, Lombok.

PHOTO: JOERG HENNING

Extracting blood from a leg-banded duck in a study to source the spread of avian influenza in the Mekong delta of Vietnam.

and preventing the spread of H5N1, fears remain that it could develop into a deadly global human pandemic.

Avian influenza is caused by a virus and, as its name suggests, is primarily a disease of birds. But late last century, probably in southern China, the highly pathogenic H5N1 strain that can kill people emerged. Officially, the first human deaths attributed to the disease occurred in Hong Kong in 1997 when it claimed the lives of six people and caused serious illness in another 12.

Since then, the H5N1 virus has been detected during outbreaks throughout Asia and in the Middle East, western Europe and Africa. Worldwide, the disease has officially infected more than 310 people, claiming the lives of at least 189. And hundreds of millions of birds, mostly domestic chickens, have either been killed directly by the disease or culled as part of efforts to contain its spread. More than 75 of the human deaths have occurred in Indonesia, all of which officials say have been restricted to the islands of Java and Sumatra.

> It is now known that it is not easy for people to catch AI from chickens or other poultry—that it requires a lot of very close contact with infected birds

It is now known that it is not easy for people to catch the disease from chickens or other poultry; that it requires a lot of very close contact with infected birds, which shed the virus via their faeces and other bodily secretions and have virus in their blood. Person-to-person transmission is very rare. In fact, there has been only one confirmed case where this is known to have occurred.

With a strong history of collaborative research into animal diseases in the Asia–Pacific, ACIAR was poised for a strong response to the bird flu crisis. It began planning research projects in late 2004 on the transmission and impact of the disease in the region, and now has investigations under way in Vietnam as well as Indonesia. These projects exploit research strengths previously demonstrated by Australia and are primarily aimed at filling knowledge gaps so that better-informed disease-control decisions can be made.

The Indonesian Government sought assistance from ACIAR directly when it realised its veterinary infrastructure could be improved. Australian Government veterinarians had already established their credentials in the area through involvement in AusAID's decade-long Eastern Islands Veterinary Services Project in Indonesia.

"Australians on that project did a great job, and it has had a long-lasting impression on the Indonesians," says ACIAR's Animal Health Research Program Manager, Dr Peter Rolfe.

The development of Indonesia's capabilities to manage AI, a trans-boundary disease with no respect for geographical or

PHOTO: PHIL SIMMONS

A market stall for fresh poultry meat in Mataram, Lombok.

political boundaries, will be helped through a new project being established by the NSW Department of Primary Industries' Dr Helen Scott-Orr.

A major logistical issue for a disease such as AI is how to manage it across different levels of government, especially in such a geographically diverse country as Indonesia. The project, which is in the early stages of development, plans to pilot an approach that would demonstrate how central, provincial and local jurisdictions can cooperate to control a range of animal diseases.

"What's really required when a virus is rapidly moving and spreading is a coherent approach, and this project will try to strengthen Indonesia's institutional capacity to define what diseases different parts of government will manage and control," Dr Rolfe says. "It's an institutional and policy-type development project, which is quite different for animal health projects in ACIAR."

There are also, of course, direct returns from ACIAR's AI work for Australia, which has so far remained H5N1-free. "Certainly, our own biosecurity is an important driver for the work we're doing," Dr Rolfe says.

And it's also been important, he says, for ACIAR's research to complement, and not replicate, efforts already under way as part of the massive global effort directed at AI.

One of the big unknowns surrounding the disease is the role ducks play in its transmission. These birds certainly contract H5N1 and their blood develops antibodies to the virus responsible, but they do not always become as sick as chickens, nor die at the same high rate. However, they can still shed and spread the virus, which suggests they may be a significant reservoir for the disease.

In a major ACIAR project that could prove critical to the way bird flu is tackled in South-East Asia, Dr Joanne Meers from Queensland University is coordinating research aimed at understanding the transmission of H5N1 in domestic ducks.

The project is focused on small-scale Indonesian and Vietnamese farmers with flocks ranging from fewer than 20 birds up to several hundred. CSIRO's Australian ↪

Bird flu facts

- Avian influenza (AI) is a disease caused by an influenza type A virus.
- H5N1 is a form of highly pathogenic avian influenza (HPAI).
- Symptoms of H5N1 in birds include respiratory distress, massive bleeding from internal organs and diarrhea, which cause nearly 100% mortality.
- Humans infected with H5N1 show flu-like signs and also eye infections and life-threatening complications such as pneumonia and severe respiratory distress.
- As of June 2007, 310 people worldwide had contracted H5N1, and 189 of those had died.
- Humans can become infected with H5N1 after eating undercooked poultry, or through very close contact with an infected animal or, extremely rarely, an infected person (probably only one episode).
- The natural reservoir of H5N1 is migratory water fowl, particularly ducks.
- H5N1 has been confirmed in 45 countries on three continents.
- Isolated outbreaks of low pathogenic AI have occurred in Australia, but so far H5N1 has not been reported.

A family-run broiler farm outside Mataram, Lombok. In tropical climates, poultry sheds are elevated to allow ventilation. PHOTO: PHIL SIMMONS

Animal Health Laboratory, in Geelong, is collaborating on the project. And in Indonesia, ACIAR researchers are working closely with colleagues at the Disease Investigation Centre, at Wates, Java. In Vietnam, the project involves a close research partnership with the Regional Animal Health Centre, in Ho Chi Minh City, and the National Institute of Veterinary Research, in Hanoi.

"There has been a lot of media coverage and extension work throughout both Vietnam and Indonesia and the public health message has been fairly well delivered," Dr Meers says. "There's a lot of funding going into different sorts of publicity: posters, radio programs and high-profile [local] movie stars recruited to get the message across. So, they've really made a lot of effort, especially to try to prevent people from becoming infected by their chickens or ducks—to minimise their exposure."

Exactly what, if any, role ducks might have played in human infections reported from Indonesia and Vietnam remains unclear.

"Most strains of AI are maintained in ducks—it's not something specific about H5N1," Dr Meers says. "What's been unusual is for ducks to become sick with any form of AI, but it now seems that certain H5N1 strains can cause quite significant disease in ducks."

The ACIAR work is investigating evidence that not all duck breeds are equally susceptible. If that proves to be the case, it could be possible to make recommendations about the best breeds to farm in the interests of minimising the flow of the disease during outbreaks.

Exactly what, if any, role ducks might have played in human infections remains unclear

The project will also investigate how well vaccines work in ducks to prevent them shedding bird flu virus. In Vietnam, where authorities have ruled that all ducks and chickens should be vaccinated, there is suspicion that recent outbreaks may have been caused by the failure of vaccines used in ducks, or the illegal raising of ducks that have not been vaccinated properly.

"So we're hoping to be able to develop recommendations for authorities about the role of ducks in general, how vaccination

might best work, and how infection in ducks could effectively be monitored," Dr Meers says. "A lot of decisions are being made now on fairly minimal evidence because they have to be. We're trying to fill in those knowledge gaps to aid development of more effective policies."

There is no question H5N1 can devastate communities that rely, directly and indirectly, on poultry for protein and as an income source. And, of course, the human infection and death toll is already tragic enough. But the really big fear is that the H5N1 virus will change to become a highly virulent human pathogen capable of claiming many millions of lives worldwide.

Because of this threat, understanding the way the virus is evolving, and watching it closely, is critical. And that is exactly what a new project headed by University of Melbourne veterinary virologist Dr Jagoda Ignjatovic is designed to do.

Supported by ACIAR, Dr Ignjatovic is investigating how the virus is changing in response to vaccination in Indonesia. There is no doubt H5N1 will change—many viruses do—but compared with other viruses, avian influenza viruses, including H5N1, show a particularly high mutation rate.

"We hope to track the changes, see the directions these mutations take, and try to predict their impact," Dr Ignjatovic says. "It's particularly important because at the moment no one is sure what particular mutations in the H5N1 virus would cause human-to-human transmission."

The work will directly assess how well vaccination is working in Indonesia to reduce the viral load in chickens and how mutations in the virus are affecting that. The project builds on close ties previously established by Dr Ignjatovic and colleagues through work in Indonesia on infectious bursal disease, an unrelated but deadly viral illness of chickens.

"It's definitely an advantage that we've already worked with the Indonesian Institute for Veterinary Science, in Bogor, one of our partners in this project, so we know the people involved and the set-up of the poultry industry," Dr Ignjatovic says.

The work also involves researchers at CSIRO's Australian Animal Health Laboratory, Geelong, and a private company, AusVet Animal Health Services Pty Ltd.

As well as its high propensity for change, the H5N1 virus also has the ability to infect a much wider range of species than most other avian influenza viruses. Already in Indonesia it has been documented in cats and pet birds, such as parrots, and may also infect dogs.

"At this stage, these species are thought to be dead-ends for the infection so they don't act as reservoirs," Dr Ignjatovic says. "But it's of concern because there are so many animals that people, particularly in Indonesia, live in close contact with."

Will H5N1 reach Australia? Some believe it's only a matter of time. It could arrive via live chickens carried on illegal fishing boats, the prohibited import of infected produce, or even migratory birds.

ACIAR's AI research activities are part of a coordinated and cooperative effort that also involves the Australian Quarantine Inspection Service and the Australian Biosecurity CRC for Emerging Infectious Disease.

"Our work provides important returns to Australia in two ways: it seeks to control the disease at its source, and if you do that it becomes less of a threat to us," Dr Rolfe says. "But there's also a capacity-enhancement side to it, whereby our scientists become familiar with and understand and experience this disease in a real-world way.

"We won't truly appreciate the importance of the capabilities and knowledge that these projects are building around the country until AI appears here." ■

Poultry markets are an important transmission method for avian influenza.

PHOTO: JOERG HENNING

Global effort to build rust shield

PHOTO: BRAD COLLIS

In response to growing concern about the damaging effects of a South American fungus on eucalypts, Australian pathologists worked with ACIAR in a bid to protect Asian–Pacific plantations and Australia's native flora from the threat of an incursion

BY GIO BRAIDOTTI

In the aftermath of an Australian bushfire, one can observe scores of slender seedlings rushing to repopulate the scorched land. Many of these fast-growing plants—be they eucalypts, bottlebrushes or tea trees—tend to belong to the myrtle family, Myrtaceae, whose 155 genera include many species that are native, endemic and iconic to the southern hemisphere.

An infectious pathogen able to parasitise new growth after a bushfire, even if it leaves old growth unscathed, presents a troubling biosecurity threat, with the potential for serious consequences—and a fungus with precisely that capability has been found to exist. Fortunately it is, for now, half a world away, which is giving scientists some breathing space in which to prepare a countermeasure for when—rather than if—the fungus reaches Australia and the Asia–Pacific.

Commonly known as guava rust, the infectious fungus *Puccinia psidii* is indigenous to South America and was only known to infect native South American plants. However, by the early 1900s industrialisation had created the need for fuel in the form of fast-growing tree species. Railway companies imported Australian *Eucalyptus* species especially suited to that task.

According to Australian plant pathologist Dr Ken Old, who has 25 years' experience at CSIRO Forestry and Forest Products, the first published report of *P. psidii* infecting eucalypts occurred as early as 1929 in Brazil.

"Normally any one particular rust species infects a narrow range of hosts, usually only one genus of plants," Dr Old says. "But *P. psidii* is a strange rust because its host range is wide. A review done in the 1990s found it infected at least nine genera of Myrtaceae. With exposure, many more may prove susceptible."

Reports of rust-affected eucalypts persisted for decades, but the first notable epidemic—on *Eucalyptus grandis* seedlings sourced from South Africa and cultivated for Brazil's rapidly developing pulp and paper industry—did not occur until 1973. At that point, the pathogen gained a second common name—eucalypt rust—and a vastly expanded potential geographical range.

The airborne fungus has been on the move. In the 1930s it became established in Jamaica, where it infected the pimenta tree and severely disrupted the allspice industry. In 1979, it found its way to Florida, where it caused several outbreaks during the 1980s. In 2005, the pathogen really alarmed Australian pathologists when it crossed the Pacific and turned up in Hawaii. However, international researchers had by this time been collaborating closely.

Dr Old says pathologists and quarantine authorities in Australia have been aware for a long time that the rust is a potentially dangerous pathogen, but nobody really had any opportunity to do sustained research on the needs of Australia and its Asian–Pacific partners: "We needed much more information about the range of susceptible

species, the parts of Australia threatened by outbreaks, and we needed a quick and accurate method for identifying the fungus in case of an outbreak."

In response, Dr Old approached John Fryer, then forestry coordinator for ACIAR, with a funding request for a three-year research project. It was approved in 2000. Of particular importance to the ACIAR project has been the involvement of Professor Acelino Couto Alfenas, of the Department of Phytopathology at the Federal University of Vicosa, Brazil, and Dr Michael J. Wingfield, Mondi Professor of Forest Pathology at the University of Pretoria, South Africa.

At the outset, half of the nine myrtaceous genera known to be rust-susceptible were native to South America. But that profile was unlikely to reflect the rust's true host range, since Australia hosts about 75 myrtaceous genera, compared with 45 for Central and South America. To obtain a better snapshot of *P. psidii* susceptibility, the ACIAR project made it possible to test not only a wide range of *Eucalyptus* species but also many more Australian native genera, including species of *Melaleuca*, *Leptospermum*, *Syncarpia* (turpentine), *Lophostomon* (brush box) and *Kunzea*.

Screening the seedlings was a major operation. Seed had to be selected or collected for a large cross-section of genera before being carefully transported to Brazil, where enough seedlings could be raised to infect and screen at Professor Alfenas's facilities. The testing was so extensive that even difficult-to-germinate, fruit-bearing rainforest species such as lillipilli were included.

"The facilities in Brazil made the whole thing possible," Dr Old says. "They include moist chambers where seedlings are incubated in the dark to maximise infection, before being moved to a glasshouse that offers temperature control to grow and then assess the inoculated plants for resistance or susceptibility. When we became involved, we assisted in setting up additional facilities to handle inoculated seedlings."

Overall, the testing found that Australian plants display a varied response to the rust pathogen, from highly resistant to highly susceptible.

"We found that some of the melaleucas are very susceptible to this rust," Dr Old says. "We tested *Melaleuca alternifolia*, the species used by the tea-tree industry along the coast in northern NSW and Queensland. We also tested a number of seed sources for *Melaleuca cajputi*, the tea tree commonly used in South-East Asia for its wood and its medicinal oil. Both these proved to be susceptible, which in itself poses a substantial threat."

Since eucalypts are usually transported as seed that can contain potentially contaminated plant material, efforts were also undertaken to test seed and pollen. Using samples from different Brazilian seed suppliers, the multinational team found that seeds and pollen can indeed carry spores of the rust disease.

That finding is likely to prove crucial for quarantine authorities, and also for the ability to run diagnostics to spot the pathogen. To help with that, the CSIRO research group developed a DNA-based tool using polymerase chain reaction (PCR) technology that requires only minute amounts of fungal samples to detect the rust.

As to what might happen should *P. psidii* breach Australia's mounting defences, Dr Old says it is difficult to predict the consequences. He adds that climatic conditions are likely to play a major role, and points to work done by team member Dr Trevor Booth to map the range the fungus is likely to have in Australia.

"Trevor looked at the climate at South American sites that are prone to rust epidemics," he explains. "Fortunately there are computer programs that allow you to compare the climatic profile of rust-prone areas with the climate anywhere else in the world."

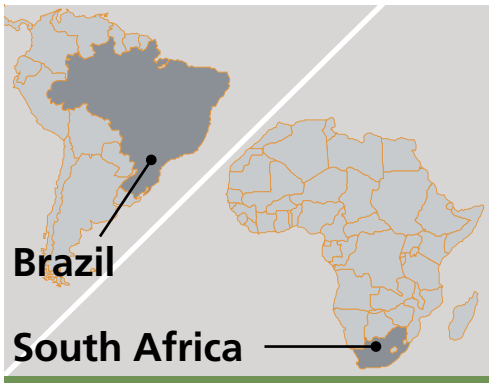
When the climate-matching technique was applied to Australia and considered alongside information about susceptible flora, a map emerged of the most at-risk sites. The area encompasses the coastal region starting around Sydney and running up to Cape York Peninsula.

"One comforting thing about this pathogen is that it mainly infects juvenile leaves, so crowns in established forests are unlikely to be infected," Dr Old says. "That limits the possibility for epidemics."

> In 2005, the pathogen really alarmed Australian pathologists when it crossed the Pacific and turned up in Hawaii

Despite the remaining uncertainties and the need for more research, the ACIAR project has already proved its strategic importance. In 2004, a particularly observant officer of the Australian Quarantine and Inspection Service noted spore-like material on wood imported from Brazil. Aware of the *P. psidii* threat, the service sent samples to the CSIRO laboratory in Western Australia, where it was confirmed that the rust had made its way to an Australian port. Additional tests also established that some of the spores were still viable.

Having proved its strategic worth, information derived from the ACIAR project has been made available to neighbouring Asian–Pacific countries to help the region defend against eucalypt rust incursions. Benefits have also accrued to Australia, South Africa and Brazil, whose eucalypt plantations alone are worth an estimated A$1.85 billion. In Australia, the data acquired from the ACIAR project is providing a basis for ongoing CSIRO research efforts as well as contingency plans to deal with the aftermath of an incursion. ■



PARTNER COUNTRIES: Brazil, South Africa

PROJECT: Assess the risk posed by a South American fungal pathogen to Australian and South African forests and native vegetation

DESCRIPTION: The project aims to assess risks from an incursion by eucalypt rust and develop the tools needed to protect Australasian and Asian–Pacific plantation eucalypts and native forests from outbreaks of the disease

Healthy livestock helps

A partnership between Laos and Australia is helping smallholder farmers protect livestock against infectious viruses

BY GIO BRAIDOTTI

Village-raised pigs add substantially to the income of Lao farmers, but pig production is under pressure from the endemic presence of infectious diseases. With an eye to alleviating this, Australia and Laos have been cooperating since 2003 to strengthen disease-control options at the village level.

Of particular concern are two viral diseases—the often-lethal classical swine fever (CSF) and foot-and-mouth disease (FMD). These two diseases disproportionately hurt Laos's most vulnerable farmers, for whom pigs can generate up to 60% of household cash income. Also affected are farmers taking the step up from subsistence level to more intensive production.

With more than 85% of the country's population located in rural areas, sales of livestock are vital to people's living standards and to poverty reduction.

To help smallholder villagers, ACIAR has been funding Australian and Lao scientists to develop methods to detect the diseases and manage them at a village level.

The original three-year project was undertaken by CSIRO scientists based at the Australian Animal Health Laboratory in Geelong, Victoria. The project was initially designed by Dr Laurence Gleeson, who has many decades of veterinary experience in Indochina.

From the start, he placed a strong emphasis on understanding the social conditions that promote transmission of livestock viruses. His project design succeeded in fostering two-way partnerships between the scientists and villagers, veterinary village workers and national disease initiatives in the Mekong region.

PHOTO: BRAD COLLIS

push against poverty

Pigs can generate up to 60% of household cash income for some of Laos's most vulnerable farmers.

Laying the foundations with foot and mouth

A new strain of foot-and-mouth disease (FMD), coupled with important developments in diagnostics, was the catalyst for an evolution in animal-health research in South-East Asia that began in the 1980s.

The two events also triggered the application of epidemiology in research across the region, which helped to better manage and control animal diseases, says Australia's Dr Laurie Gleeson—one of the leaders of ACIAR's projects to research and develop FMD diagnostic methods and control FMD.

The ACIAR-funded work began in Thailand in the mid-1980s when a new strain of FMD struck. Although Thailand had an FMD vaccine-producing facility—at Pak Chong, 200 kilometres north-east of Bangkok—the new strain was causing substantial damage to livestock production, especially pigs.

FMD is one of the most important animal-health issues in South-East Asia, inflicting substantial economic losses because of reduced animal growth rates and work output. It also retards trade in livestock and livestock products, reducing farmers' returns from animal production.

Dr Gleeson, formerly with CSIRO Animal Health and now with the UN's Food and Agriculture Organization (FAO) in Bangkok, says Thailand's vaccine, produced at Thailand's Department of Livestock Development (DLD) facility and used since the 1950s, was not controlling the new strain of FMD type A.

"At the same time, CSIRO staff had developed a new diagnostic test for FMD and needed to validate it, using field samples."

He says it made sense to establish a project to validate the test and diagnose the new FMD strain, providing insight into why the vaccine was not working.

This work, which in various project guises lasted for more than eight years, was very successful, Dr Gleeson says. "The test eventually became the standard test for FMD and helped control FMD in Thailand."

The projects also helped in the development of more accurate diagnostics for detecting different strains of FMD and led to a better understanding of the relevance of certain FMD strains and their impact on vaccine performance.

"There have been many spin-offs from this work," he says. "DLD with technical advice from CSIRO established a bio-containment facility—a regional reference laboratory that can safely conduct studies on new strains of FMD from around the region. And the whole process has increased engagement with regional and international bodies."

He says one of the most important achievements from a research and development perspective—and one that has had effects on other animal-health projects—has been the increasing use of epidemiology to better understand and control disease.

Dr Gleeson says that, even now, his avian influenza work with FAO is based on this. "Even though I've moved from four-legged animals to two-legged ones, it is based on the increasing use of epidemiology and the FMD work we started in Thailand in the 1980s."

– REBECCA THYER

Leadership of the project has since shifted to CSIRO's Dr Axel Colling, but it has retained and strengthened its collaborative nature.

"The project was designed on the understanding obtained from going out in the field and interviewing people who helped us properly contextualise the livestock disease issues," Dr Colling says. "The information included how piglets are bought and sold at village markets, since mixing of animals provides a perfect opportunity for infectious material to spread."

A wealth of information was obtained in the process, which is helping to break the disease cycle, sometimes in simple ways that do not necessarily rely on sophisticated, laboratory-based technology. "For instance, we found that in the early stages of a CSF outbreak, farmers frequently decided to sell piglets, without realising that the disease may be infectious," Dr Colling says.

The team also found that market animals were often dehydrated, hungry and stressed—conditions that help spread infectious diseases between animals and from animals to humans, as in the case of SARS and avian influenza.

As the project progressed, regional workshops were held and educational material was developed for use by interested parties, such as veterinary village workers. Indeed, the job of raising awareness on how the cycle of CSF infection is being maintained at the village level is viewed as equally important as the more technical work on rapid diagnostics and vaccines.

"Smallholders now realise they are better off confining new pigs separately for a few weeks and mixing them with village pigs only if they remain healthy," Dr Colling says. "They have started to understand the principle of preventative medicine based on an understanding of how microbes spread diseases. These farmers are very clever and they have an enormous capacity to cooperate and communicate. So when a village sees the benefits of disease control—in terms of healthy piglets—the methods tend to be rapidly adopted and copied."

Since the critical end-users are mostly women, who make up the bulk of pig farmers, the Lao Women's Union is playing a critical role facilitating information transfer through their extensive village-based network.

On a more technical front, a need was identified for rapid diagnostic capability that could be deployed at the village level, rather than relying exclusively on sending samples to the national testing facility in the capital, Vientiane. Such a tool could also help in assessing and refining the performance of CSF vaccines that are under development in Laos.

PHOTO: BRAD COLLIS

When a village sees the benefits of disease control—in terms of healthy piglets—the methods tend to be rapidly adopted and copied.

Classical swine fever

- Highly contagious viral infection of swine that is often fatal.
- Most often spread by movement of infected pigs and ingestion of contaminated feed or garbage.
- Outbreaks have occurred throughout much of the world. The disease is present in some European countries, South America and Asia.
- Symptoms usually appear five to 10 days after infection. Acute symptoms include persistent high fever, weakness, lethargy, uncoordination, huddling, anorexia, conjunctivitis, constipation and/or diarrhoea, and reddish/purplish discolouration of the skin of the abdomen, inner thighs and ears.

Foot-and-mouth disease

- Highly contagious and sometimes fatal viral disease of cloven-hoofed domestic animals, primarily cattle, pigs, sheep and goats.
- Occurs throughout much of the world with endemic areas in Asia, Africa and parts of South America.
- Spreads rapidly by contact with infected animals and transmission on clothing and vehicles, and through the air.
- Principal symptoms are dullness, loss of appetite, fall in milk production, fever, excessive drooling, and severe lameness or reluctance to walk.

PARTNER COUNTRIES: Laos, Cambodia, Thailand, Vietnam, Indonesia

PROJECTS: AH/2003/001: Management of CSF and FMD at the village level in Laos PRD; AH/2006/025: Understanding livestock movement and the risk of spread of trans-boundary animal diseases; and AH/2004/020: The development of a national surveillance system for classic swine fever and foot-and-mouth disease in Indonesia

DESCRIPTION: ACIAR is funding key projects in animal health to eradicate or control trans-boundary animal diseases, through a greater understanding of livestock movements, plus better surveillance and diagnostic techniques

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While a laboratory-based diagnostic technique called ELISA (enzyme-linked immuno-sorbent assay) already exists for CSF and FMD, the technique relies on attaching virus-detecting antibodies to specialised plastic trays—trays that require expensive equipment to process. To make the diagnostic assay workable in laboratories closer to the smallholders meant somehow decoupling the assay from its need for elaborate support equipment.

The breakthrough came when Jamie Conlan, who spent many years in Laos doing experimental work for his Master of Science degree, came up with the idea of attaching the antibodies not to plastic trays but to magnetic beads. That innovation allows a hand-held magnet to substitute for the equipment normally needed to perform the assay. The resulting diagnostic tool has been dubbed the IMB-ELISA (immuno-magnetic bead ELISA).

"Despite needing less sophisticated laboratory support, we found that the new test's performance characteristics are similar to the established and more sophisticated technique," Dr Colling says. "So the test is an ideal candidate for the diagnostic needs of smallholders in Laos."

So far, the new system has been set up at four provincial laboratories, where it is now possible to arrive at a preliminary diagnosis within 35 minutes of receiving a sample.

If positive for CSF, the case is further examined for an outbreak and biosecurity options may be recommended, such as putting the affected animals under quarantine or even culling. This is done with the understanding and cooperation of the smallholder, once again emphasising the importance of the education and training efforts that preceded the introduction of the diagnostic tool.

> "Smallholders now realise they are better off confining new pigs separately for a few weeks and mixing them with village pigs only if they remain healthy."
>
> – DR AXEL COLLING

"Irrespective of whether samples are positive or negative, they should be forwarded to the central animal health laboratory in Vientiane for further testing as soon as possible," Dr Colling says. "It is important to understand that the use of hand-held testing devices is useful as an additional and rapid diagnostic tool but should never be regarded as a replacement for other laboratory-based tests."

In the next stage of the project, preparations are under way to support the assay's introduction across the region ↪

The importance of surveillance

Reducing animal diseases to a manageable level ultimately requires a surveillance system that can track their presence. A project to build such a system has just started in Indonesia, funded by ACIAR.

The project is headed by Associate Professor Ian Robertson from the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Diseases at Murdoch University, in Western Australia.

"Monitoring the prevalence of endemic and emerging diseases is a vital part of evaluating the effectiveness of new and established disease-control programs," Associate Professor Robertson says. "The ACIAR project started in 2006 and will help Indonesia strengthen its surveillance system for animal diseases, particularly in the eastern part of the country, where recent outbreaks of major pandemic livestock diseases have included highly pathogenic avian influenza (HPAI) and classical swine fever (CSF)."

PHOTO: BRAD COLLIS

As in Laos, CSF has a serious effect on animal productivity and is now widespread in the eastern islands. HPAI has led to the death and destruction of large numbers of poultry in Indonesia (see page 4).

Associate Professor Robertson says risks from these diseases can be reduced by targeted active surveillance and an increased awareness of the disease. Indeed, Indonesia has already been successful in eradicating foot-and-mouth disease (FMD), an important move for improved productivity and for growth of livestock exports.

in a way that ensures uniformly high performance levels.

"There is no test anywhere in the world that perpetually gives correct results, given that over time different reagents and testing conditions are used to target different populations," Dr Colling says.

Support is being provided to Laos in the form of a standard operating procedure that encompasses the use of internal controls to better recognise false-positive and false-negative results, and that acts as a means to ensure testing procedures, reagents and operator proficiency remain effective.

The availability of the assay is also affecting efforts to refine the performance of CSF vaccines under development in Laos. The CSIRO team has identified issues regarding the quality of vaccine production, storage and application to animals. Ms Tess Vitesnick has spent almost a year in Laos working on these issues under the Australian Youth Ambassador for Development Program.

"If it is too difficult to improve the quality of locally produced vaccine, there is always the option of using good quality-controlled vaccines originating from neighbouring countries," Dr Colling says, stressing that any compromise on vaccine quality can boomerang on a program. If farmers do not see the preventive effect, they start to question the entire principle, with devastating consequences.

"These are issues that need to be worked on at the ministry and policy level, but we are working on all these levels and talking to everybody concerned."

With strengthened disease-control measures taking form, interest is gathering for a region-wide control program from neighbouring countries such as Laos, Cambodia, Vietnam and Thailand.

"The Asian Development Bank has given an enormous amount of money over the next few years for concerted control programs," Dr Colling says. "ACIAR has seen these developments and is targeting research efforts accordingly."

Of critical importance is the spread of diseases across borders, and a new ACIAR project headed by Dr Chris Hawkins is specifically looking at this issue. It is being undertaken in partnership with the World Organisation for Animal Health (OIE) working through its Regional Coordination Unit in Bangkok and the Australian Department of Agriculture, Fisheries and Forestry.

Dr Hawkins, a senior veterinary epidemiologist, based at the Department of Agriculture and Food, Western Australia (DAFWA), says that national borders do not mean much when it comes to infectious disease. As a consequence, understanding livestock movement patterns can provide essential information to control efforts.

"A detailed, quantitative understanding of these patterns and their influence on the spread of disease is critical," Dr Hawkins says. "It allows the identification of high-risk livestock movements so that preventative action can be taken. It also serves as a platform to develop novel strategies to minimise the risk of disease spreading."

Dr Hawkins cautions that the move by South-East Asian countries to manage and eradicate animal diseases could lead to increases in quarantine controls. If not done carefully, these measures can reduce producers' incomes and potentially lead to financial hardship.

"There tends to be a certain volume of unregulated or informal movement across borders, which can lead to the further spread of disease. That's why working with producers and traders to make these movements safe will benefit all South-East Asian countries."

Australia also stands to benefit given the volume of tourism to the region. "The risks of inadvertently bringing unwanted organisms back to Australia should be diminished by this kind of project."

Dr Hawkins and the team, which will collaborate with Cambodian and Lao veterinary services, Australian partners Murdoch University and AusVet Animal Health Services, while maintaining close links with the Bangkok regional office of the Food and Agriculture Organization of the United Nations, will start surveying and mapping animal movements by gathering information from livestock traders, marketers and buyers. The researchers will also attempt to follow consignments in the target areas in Cambodia and Laos.

"We aim to empower veterinary services and collaborating projects to improve disease control through a better understanding of movement patterns and drivers," he says. "Any decrease in trans-boundary diseases will have positive effects on poverty alleviation, trade and reducing the cost of remedial measures." ■

Stopping the wilt

Wilt diseases have devastated banana crops in Indonesia. Two ACIAR projects are attempting to manage the invasion —and protect unaffected neighbours

BY JENNI METCALFE

When Cyclone Larry crossed the north-eastern coast of Australia in March 2006, it destroyed most of Australia's commercial banana crop and sent consumer prices rocketing. The cyclone cost Australia's banana growers almost $500 million in lost production and re-establishment costs.

So imagine the devastation if a disease such as Fusarium wilt, especially the virulent Tropical Race 4 (TR4) strain, were to hit northern Queensland. An outbreak of the disease would require eradication and regrowth of clean crops, putting even more financial strain on the region. ↪

PHOTO: PETER TAYLOR

A bunch of bananas cut open to reveal symptoms of blood disease.

PHOTO: JEFF DANIELLS

Project staff discuss on-farm disease management with a banana grower near Baso, Sumatra.

When TR4 hit the Northern Territory's banana growers, wiping out most of their production in 1997, the rest of Australia's production area was understandably nervous.

Fusarium wilt is caused by a fungus, which turns the outer leaves of a banana plant yellow before it moves to the younger leaves. When the stem at the base of the plant is cut, brown streaks are visible where the invading fungus releases toxins, blocking the water-conducting vessels of the plant and killing it. Fusarium wilt affects almost all varieties of banana, including the popular Cavendish.

Fusarium wilt and a second wilt disease, blood disease, have devastated banana crops for smallholder farmers and backyard growers in Indonesia, where export income from bananas fell from a high of $22 million in 1996 to just $150,000 in 2002.

Blood disease is caused by the blood disease bacterium (BDB), which is carried to the plant by insects visiting the male flowers. The bacteria multiply in the flowers and grow down the stem of the plant towards the fruit, turning the flesh into red ooze. Generally, the symptoms of wilting and yellowing appear first in the youngest leaves of the plant.

Dr Siti Subandiyah, from Indonesia's Gadjah Mada University, says the two wilt diseases are still the most severe disorders affecting bananas in Indonesia, and have spread across many provinces.

"The last severe infection was in late 2006 in South Kalimantan when most banana crops, especially the cultivar Kepok, were severely damaged by BDB," Dr Subandiyah says. Given that bananas are Indonesia's most important horticultural crop and an important staple food, these sorts of disease invasions are devastating.

The need to protect unaffected countries and regions, as well as to find better ways of managing the diseases once they do invade, is driving two ACIAR projects in Indonesia and Papua New Guinea.

"It is important that every country in the region knows what kind of wilt diseases they have and where they are distributed," says Dr Augustin Molina, ACIAR project coordinator and Bioversity International's regional coordinator for Asia and the Pacific. "This knowledge leads to the development of rational inter-country as well as intra-country quarantine policies to prevent the further spread of diseases. For example, many of the important banana varieties grown in Papua New Guinea may be susceptible to TR4. Knowing what disease types are already present in PNG, and neighbouring Indonesia, helps to prevent TR4's invasion."

Bob Williams of the Queensland Department of Primary Industries and Fisheries (QDPIF), the ACIAR project leader, believes it is important to know how to live with such diseases if they do strike Australia.

"By working in Indonesia and PNG we're getting a better indication of the movement of disease, and how and when it might arise and what path it might take," Mr Williams says. "We can better understand how we could live with the disease if it did come to Australia, what management practices will minimise impacts, and how to change production practices and make conditions unfavourable for disease."

The first ACIAR project began in 2005 at the request of the Indonesian Government, which was concerned about smallholder banana growers dealing with the devastating effects of wilt diseases. Project leader Dr Peter Taylor believes the Indonesian research will also help Australia if any of these diseases enter the country.

"We have made considerable progress in understanding these diseases. And we now have improved diagnostic tests for detecting them," Dr Taylor says.

The project has improved the robustness of a polymerase chain reaction (PCR) test aimed at detecting BDB even if plants have not started to visibly 'ooze'.

"We have established best-practice management options for wilt diseases," Dr Taylor says. "We'll be working with extension agencies and the Indonesian Banana Wilt Task Force to get these results

PHOTO: NASRIL NASIR

Farmers and students from Andalas University in Padang, West Sumatra, led by researchers from the Indonesian Banana Research and Development Center, inspect an area infected by wilt diseases at Agam that will be used for ACIAR research.

PARTNER COUNTRIES: Papua New Guinea, Indonesia

PROJECTS: CP/2005/136: Mitigating the threat of banana Fusarium wilt; CP/2004/034: Diagnosis and management of wilt diseases of banana in Indonesia

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out to farmers through existing networks and farmer discussion groups."

The project has also set up field trials to test biocontrols against Fusarium wilt and to use as demonstration plots for BDB control measures.

Mr Malin, a farmer in Baso, Sumatra, and chairman of a local group of farmers, says nearly 70% of the bananas have been infected by wilt diseases in his region since 2002. Most attempts to re-establish banana crops in the region have failed, but Mr Malin says that the ACIAR banana plants were "higher and healthier" than other plants in the region after three months.

The second ACIAR project, managed by Dr Molina, began last year to complement the first project and focus specifically on various forms of Fusarium wilt disease. It aims to map out the geographic spread of the various forms of the disease, validate diagnostic tools and produce a disease-management manual of farmer-evaluated methods. In particular, it aims to promote national strategies that improve the region's capacity to exclude, contain and control Fusarium wilt.

The project has already surveyed the major banana-producing areas of Indonesia and collected infected plants. A similar survey is about to start in PNG. The project has also selected sites in Lampung and East Java in Indonesia to develop and test disease-management methods that are appropriate for local conditions.

The 'best-bet' methods recommended by researchers will be packaged to include resistant plant varieties, biocontrol, use of low-cost tissue cultures for planting, routine monitoring and eradication, and use of annual cropping systems. These will be compared with farmers' existing practices.

Dr Molina believes it is essential to involve farmers in such tests. "By involving farmers right from the start, in a participatory approach to developing or validating disease-management strategies, we are able to improve the relevance of our project, making sure that it answers their needs. It makes them own the project. Then the farmers can serve as effective 'extension agents' to other farmers."

The work in Indonesia, and now PNG, is just the start of regional and even global efforts to manage threats to banana growers from diseases such as Fusarium wilt and blood disease. ■

PHOTO: AGUSTIN MOLINA

External symptoms in the pseudostem of a banana plant with Fusarium wilt show rotting of the vascular tissues that eventually leads to wilting of the plant.

Keeping blight off the landscape

Previously free of potato late blight, Papua New Guinea is witnessing the invasion by an aggressive disease strain that is devastating many smallholders

PHOTO: R.F. DE BOER

International scientists examine a potato crop in the highlands of PNG.

BY RACHEL SULLIVAN

The highlands of Papua New Guinea were, until recently, home to a flourishing potato industry. In early 2003, healthy potato plants started rotting where they stood. Potato late blight, the disease responsible for the Irish potato famine in the 1840s, had made landfall, and immediately began devastating one of the PNG highlands' important cash crops.

Potato late blight is caused by the fungus *Phytophthora infestans*, and various strains are found in potato-cultivating regions throughout the world. Over time, management strategies, including the development of fungicides and the introduction of new, blight-resistant potato varieties, have helped combat the disease. But recently, new virulent strains from Central America started spreading rapidly throughout North America, Europe, Africa and Asia, having a dramatic impact on potato crops wherever they appeared. It is this aggressive fungus that has invaded previously blight-free PNG.

Before the outbreak, commercial trade from smallholders and a few larger commercial growers had reached 15,000 tonnes of potatoes each year, with a total value of 10–15 million kina. Barter trade was also widespread. According to Dr Birte Nass-Komolong from the PNG National Agricultural Research Institute (NARI), the wholesale destruction caused by potato late blight has devastated many smallholders.

"Only a limited number of crops can be grown at high altitude," she says. "Slow-growing sweet potatoes are a food staple, while quick-growing 'spuds', known locally as English potatoes, are grown partly for the farmers' own consumption, and partly as a source of income to pay for school fees, kerosene, sugar and salt. Without this income, survival becomes a real struggle."

The highlands climate is ideal for late blight, she says, meaning that intensive control regimes such as spraying with fungicides are essential. Unfortunately, these are also expensive: crops need to be sprayed every three to five days, and the replacement seed potatoes, chemicals and equipment are beyond the means of most smallholders.

"Even though people have lost confidence in growing English potatoes, they find it very difficult to switch over to cultivating a new crop, so it is essential we identify and distribute resistant varieties," Dr Nass-Komolong says. And while commercial growers have been affected, late blight has not had the same impact as it has on smallholder farmers because commercial growers are able to afford seed, crop sprays and the labour to apply them. However, exposure to large amounts of chemicals is an issue for the labourers, the environment and possibly consumers.

PHOTO: R.F. DE BOER

Potatoes (cultivar Sequoia) on sale in the Mt Hagen market.

PHOTO: R.F. DE BOER

Potato late blight symptoms on potato leaves.

PHOTO: ANDRE DENTH

A potato crop in Mt Hagen is sprayed with fungicides to control potato late blight.

Supported by ACIAR since 2005, NARI, in association with PNG's Fresh Produce Development Agency (FPDA), has been collaborating with other agencies around the world, including the International Potato Center (CIP), Australia's Victorian Department of Primary Industries and the University of Queensland.

As the foundations of a suite of safe and cost-effective integrated management strategies are being developed for the new cultivars, these agencies are working together to evaluate and introduce affordable, resistant potato varieties to minimise the need for fungicides, and to identify low-impact, reliable fungicides in case of emergencies. Over the longer term, NARI and its allies have also set up an extension program, working with local farmers to help rebuild local confidence in potato cultivation.

Approximately 50 different potato clones, developed by the CIP for the tropical highlands climate, are being evaluated by NARI and FPDA researchers. Using tissue culture to multiply the available plant material for further testing, four varieties are being fast-tracked so the seed can be given to local farmers to grow alongside their existing crops.

As part of a process of identifying and field-trialling resistant new varieties, these farmers will provide feedback to NARI and FPDA researchers about tuber shape and size, number of tubers, foliage growth, growing period, taste and cooking requirements. The resistant varieties will then be placed in the hands of farm extension networks, where liaison officers will work with villagers to ensure they will again be earning an income from potatoes.

However, at the moment seed potatoes remain very expensive and in short supply. To help boost stocks, a NARI pathologist and agronomist recently spent two weeks in Australia working with the Victorian Department of Primary Industries' Dr Rudolf de Boer and his team on advanced tissue culture and field-evaluation techniques. This follows on from similar training given to a NARI potato propagation specialist in 2006.

Dr De Boer says that this is part of an ongoing mentoring program that not only helps ensure PNG's protocols are up to speed, but helps enhance Australia's disease awareness and preparedness, and ensures the biosecurity of the region.

"Potato late blight is one of the most important diseases on the planet," he says. "By helping our nearest neighbour, we are also helping ourselves to prepare for the possibility of an outbreak of this resistant strain in Australia." ■

Papua New Guinea

PARTNER COUNTRY: Papua New Guinea
PROJECT: CP/2003/029: Management of potato late blight in Papua New Guinea
CONTACT: Dr Rudolf de Boer, dolf.deboer@dpi.vic.gov.au

Potato late blight facts

- Caused by the fungus *Phytophthora infestans*.
- Symptoms include pale lesions on the tips or margins of young foliage, eventually turning black and sometimes surrounded by a yellow halo; downy white mildew on the underside of leaves in humid conditions; the skin of tubers develops purple-brown blotches.
- Various strains found in potato-growing areas throughout the world, including the Americas, Europe, Asia, Africa, the tropics and Australia.
- Spread through infected tubers, or by wind or water dispersal of spores carried on the undersurface of leaves.

On the white spot

PHOTO: PETER WALKER

On-farm and in the laboratory, researchers are working to help smallholder shrimp farmers shield their stock from white spot and other diseases

BY ROBIN TAYLOR

The mysteries of a dangerous shrimp disease, estimated to have cost Asian farmers billions of dollars in lost production, are being unravelled through a two-pronged research approach.

Since 1996, a number of ACIAR projects have helped shrimp farmers across Asia tackle white spot disease (WSD), caused by the white spot syndrome virus. The work has important flow-on effects for Australian shrimp farmers.

Project leader Dr Richard Callinan says WSD is mysterious because there are a number of ways it can enter farmers' ponds. The project team knew that the virus, despite everyone's best efforts, would probably find its way into most ponds during the course of the crop.

"The trick is to help farmers understand how to manage a crop through to a profitable harvest, without tipping the balance in favour of the virus and triggering a catastrophic disease outbreak," he says.

Dr Callinan says the work is important as shrimps provide a valuable source of income for many smallholder farmers in Asia.

World production of farmed shrimps was valued at more than US$10 billion in 2005, with about 80% of production coming from Asia, largely from smallholder farmers.

In Indonesia, shrimps are the most important fisheries export. More than one-third of production comes from traditional extensive systems on small farms of less than two hectares.

These farmers have limited capacity to control production factors such as quality of seed (the tiny shrimps used to stock the pond) and the supply and quality of pond water.

Dr Callinan's project aimed to tackle these issues by working with farmers in Thailand, Indonesia and India to develop best-management practices for shrimp farming.

Tapping into existing village-based farmer groups, the research team from the Directorate General of Fisheries, Indonesia, and the NSW Department of Primary Industries worked with key farmers in East Java and South Sulawesi to develop best-management practices.

They delivered training to farmers using demonstration ponds operated by the leading farmers.

Dr Callinan says better health-management practices are based on three principles:

- minimising the risk of introducing the virus into the pond with the seed;
- keeping the virus from entering ponds via other sources such as infected crabs or contaminated water; and
- good pond management, such as maintaining water quality to avoid stress on the shrimps.

Smallholder prawn ponds under cultivation in the West Godavari District of Andhra Pradesh, India.

He says the chances of success increase as the number of farmers participating increases. If a group of farmers in close proximity uses these principles, the level of viral contamination in an area is reduced, because there are clean farms close to one another.

Dr Callinan says that in parts of South Sulawesi, for example, where the soils are porous and ponds lose about five centimetres of water a day, farmers have to regularly replenish the water, which increases the potential for viruses coming in from neighbouring farms and infected waterways.

Conditions differ markedly between traditional (extensive), semi-intensive and intensive systems. Traditional ponds have a low stocking rate of about one to six shrimps per square metre, compared with about 15 for semi-intensive systems and 40 for intensive systems. In traditional systems, which are used by about 75% of Indonesian smallholder farmers, operators do not use paddle wheels to aerate the water and may feed shrimps with artificial feed for only part of the cropping period, if at all.

The project had mixed success in converting traditional farmers to the best-management approach. Although many key farmers were able to grow shrimps effectively and not lose them to disease, other farmers were discouraged from adopting the methods because they could not access the credit needed to convert their traditional systems to semi-intensive ponds.

However, there was unexpected, enthusiastic adoption of the recommendations among non-target, traditional farmers in areas surrounding the demonstration site in Gresik in East Java, thanks to one of the key farmers, Mr Ridwan. He applied the new management practices that he was using in his semi-intensive ponds to his traditional extensive ponds, with great success. His neighbours, who all used the traditional system, noticed this and approached him for help. This group of farmers has now successfully produced several crops of high-quality shrimps.

"Given the right sort of extension support, there is no reason why this can't go further in Indonesia," says Dr Callinan, who is coordinating a second phase of the project.

He and his team are going back to Java and South Sulawesi to work on traditional farms, saying the researchers now know much more about the best-management practices suited to traditional farmers.

At the laboratory level, another ACIAR project aims to reduce the impact of WSD in farmed shrimps. Project leader Dr Peter Walker, of CSIRO Livestock Industries, says that although the disease has been widely studied, outbreaks continue to occur. "These can be devastating for small farmers."

The project is building on a major initiative coordinated by the Network for Aquaculture Centres (NACA), an inter-government agency based in Bangkok. NACA is working with smallholder farmers and government agencies in India to apply best-management practices to reduce disease risks.

The project also builds on the results of an earlier ACIAR project, which focused on improving scientific knowledge and developing technologies to increase diagnostic capabilities in Thailand and Australia, with expected flow-on throughout the region.

That project included a strong training component, promotion of ↳

PHOTO: CSIRO

Dr Peter Walker and members of the field team discuss pond performance data collected on site in Andhra Pradesh, India.

White spot disease (WSD)

- WSD is caused by white spot syndrome virus.
- Symptoms include rubbing of the body against rocks, no response to feeding, lethargy, red discolouration of the body, and pinhead-sized white spots on the body or fins.
- The virus first emerged in China in 1992 and has since spread to most shrimp-farming countries around the world.
- WSD has cost the farmed-shrimp industry billions of dollars in lost production over the past 10 years, and can be devastating for smallholder farmers.
- Research supported by ACIAR has developed polymerase chain reaction (PCR) and epidemiological tests to identify the diseases.
- The use of PCR-screened seed, along with best-management practices on-farm to reduce stress and prevent transfer of the virus between ponds, is the best insurance a farmer can have against crop failure.

standard diagnostic procedures and commercialisation of diagnostic kits. A shrimp virus-detection kit developed by CSIRO Livestock Industries and Mahidol University, Bangkok, is being produced commercially.

The kit detects very low levels of infection in prawn populations, and can be used to source virus-free broodstock and monitor populations to keep them virus-free.

There are now about 20 diagnostic laboratories in Thailand that undertake polymerase chain reaction (PCR) testing, providing services to about 80,000 small-scale shrimp farmers.

One of the main causes of disease is infected seed, so a key factor in getting a crop through to harvest is screening the seed to make sure it is not infected with the white spot syndrome virus.

The earlier project developed methods for detecting both white spot and yellow head virus using PCR. This screening for white spot syndrome virus in seed shrimps was the key element in the success of a rescue-and-recovery plan to eradicate viral diseases in the Thai shrimp-culture industry, which has resulted in an estimated extra 600,000 tonnes of shrimp production since 1996.

By using specific genetic markers, the researchers can also use PCR to trace the source of the virus in the hatcheries and ponds. When a crop fails, they can tell exactly how the virus entered the system.

In the current project, the researchers are using these genetic markers in a large field-trial in Andhra Pradesh, India, to pinpoint the sources of infection and help prevent the disease. The project is also helping to increase the reliability of seed screening by training laboratory technicians and key scientists in PCR technology.

More than 25 people have been trained in the program, and several scientists have received training at the Australian Animal Health Laboratory in Geelong, Victoria.

Two workshops in India have also introduced a novel calibrating service for laboratories and hatcheries across the country.

Participation in the inter-calibration exercise is voluntary and results are strictly confidential. Thirty-eight laboratories were asked to test samples on their own, using the PCR test kit of their choice. Each laboratory could view their own results and compare them with others.

"The anonymity allowed us to give confidential feedback to the participating laboratories, as well as to the agencies involved in trying to manage the situation," Dr Walker says.

A replica of the project is also under way in Indonesia, where another 25 technicians have been trained in PCR and inter-laboratory calibrations have been conducted.

"This inter-calibration of PCR service laboratories and hatcheries is the first to be conducted anywhere in the world," Dr Walker says. "We see this as the first step in a model for the Asian region. If we get it right in India and replicate it in Indonesia, I believe we'll get uptake by other governments throughout the region."

India's Marine Products Export Development Authority (MPEDA), which provided financial support for the project, now wants to introduce a national accreditation program for testing laboratories.

Results from research into shrimp diseases in Asia will help Australia protect its own shrimp-farming industry against WSD.

"Australia remains disease-free, but the potential for outbreaks cannot be ignored," Dr Walker says. "Through this project we are learning how to best manage the disease, which should reduce the risk of introduction and improve our response if an outbreak does occur."

Yellow head virus and white spot syndrome virus are both exotic to Australia, but a yellow-head-like virus (gill-associated virus, or GAV) is known to affect Australian cultured shrimps.

Researchers in the ACIAR projects made important progress in understanding the epidemiology of GAV outbreaks on Australian farms. Results have been incorporated into a best-practice manual for Australian farmers, produced in collaboration with the Australian Prawn Farmers Association.

New low-cost technology, such as a pond-side enzyme-linked immuno-sorbent assay (ELISA) test, has also been developed, with the potential to benefit farmers in Australia and Asia. ■

PHOTO: PETER WALKER

A farmer displays produce from a successful crop of black tiger shrimps at a distribution centre in Andhra Pradesh, India.

PARTNER COUNTRIES: Thailand, India, Indonesia, Vietnam

PROJECTS: FIS/2002/075: Application of PCR for improved shrimp health management in the Asian region; FIS/1996/098: Diagnostic tests and epidemiological probes for prawn viruses in Thailand and Australia

DESCRIPTION: These projects aimed to help Asian shrimp farmers fight the viral disease white spot syndrome through on-farm practices and via virus screening in the laboratory

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RESEARCH A FAMILY PASSION

Dr Luis Rey Velasco's affinity with the University of the Philippines, Los Baños, dates back decades. The newly appointed chancellor is entering a new chapter in this history, with the hope that hard work and focus will see his research dreams turn into reality

BY REBECCA THYER

Dr Luis Rey Velasco's passion for agricultural research and the University of the Philippines (UP) started long before he became the university's Los Baños chancellor, or even undertook his undergraduate degree there.

During his childhood, Dr Velasco spent a lot of time at the university with his father, Dr Jose R. Velasco, a former professor emeritus in plant physiology. Dr Velasco credits his father as being a major influence on his academic choices and where they have taken him.

The professor of entomology, who was sworn in as chancellor of the Los Baños campus in 2006, says his new role is a privilege as well as a great challenge.

"It is an honour to contribute to an institution that has touched, even in a small way, the lives of many great men and women who have crafted, and who will craft, the destiny of science and development in my country," he says. "But it is also a challenge because your colleagues demand and expect the best of the chancellor, nothing less."

Dr Velasco expects to invest time and energy in both of his roles as an agricultural researcher and chancellor, saying he is excited by the potential to contribute to scientific knowledge and the chance he has been given to be a part of the education of young men and women.

The Los Baños campus specialises in agricultural, forestry and rural development research, areas crucial to improving the lives of millions of people in the Philippines. "In a country where more than 50 per cent of the population is engaged in farming for their livelihood and most suffer varying degrees of poverty, agriculture and agricultural research is obviously of critical importance," Dr Velasco says.

For farming families, agricultural research and development (R&D) needs to address two crucial issues, he says. It has to help provide a reliable food source, and it has to generate a decent income. "The ultimate goal of agricultural R&D is to improve farmers' economic standing and quality of life, but it must also ensure that the interests of future farmers are not compromised."

In a wider context, Dr Velasco says there is a distinct challenge in balancing immediate needs with longer-term structural requirements. "On one hand there is a need to address food security for political stability. Then on the other hand we need to ensure our farmers can compete in a global free-trade economy, for local agriculture to become a viable industry."

This creates competing demands for agricultural R&D, especially when the supply and quality of resources is deteriorating.

As a researcher and as an educator, Dr Velasco is at the sharp end of the question—how to produce more food when there is a diminishing land area, an increasing population and the effects of global warming are unknown.

These are quite possibly the easy questions, compared with problems such as these: "How do we make agricultural products more affordable as well as provide a decent income for farm families? And how do we address the economic and political barriers of food sharing in the face of massive hunger and poverty?"

Dr Velasco acknowledges that value-added agricultural products, high-value crops and crop diversification offer potential, but these raise economic issues that have to be thought through carefully. "Who will take the risk and fund value-added infrastructure? Can farmers afford high-risk crops if returns are not immediate?"

For him, the challenge is to develop new economic paradigms that address such problems and keep farmers on the farm. Incentives and subsidies have to be provided to allow farmers to be responsible in the face of deteriorating land and water resources, and to eliminate practices that harm community and environmental health.

To this end, he says, ACIAR has helped to broaden the region's agricultural R&D focus by encouraging new ways of thinking: "To my mind, ACIAR's most important contribution is bringing new paradigms and thinking to agriculture and rural development in my country and the region."

Dr Velasco, who likens his chancellor role to that of a CEO—providing leadership, crafting a vision and setting goals—says his personal approach and hope for achieving goals is to seek to transform dreams into reality. "My philosophy is very simple—be an optimist, dream, focus and work hard," he says. "And if you still fail, that is good, because the second time around you will be better prepared." ■

Melanie Sim interviews a farmer (left) just outside of Hanoi, Vietnam, with the aid of a translator.

ACIAR and Crawford Fund sponsor ABC journalist

HANOI: As part of the launch of a new project in Vietnam, ACIAR and the Crawford Fund supported ABC rural journalist Melanie Sim to travel to Hanoi and report on Australian-funded research activities. On 7–8 May 2007 a workshop attended by the Vice-President of Vietnam, Mme Truong My Hoa, the Australian Ambassador to Vietnam, His Excellency Mr Bill Tweddell, and other Vietnamese dignitaries was held to launch an ACIAR project aimed at enhancing the role of women in the production and use of indigenous vegetables.

The project was initiated by Mme Hoa and the Vietnamese Women's Union, a group with about 13 million members across Vietnam. Melanie was able to speak with Mme Khiet and Women's Union representatives about the challenges of farming in Vietnam, and the potential that indigenous vegetables offer women, particularly for income generation. Melanie also accompanied ACIAR and project staff to several vegetable farms, markets and research stations in and around Hanoi.

Although Vietnamese vegetable farming is a far cry from Shepparton and the Goulburn Valley, where Melanie reports on Australian rural issues, she did see some similarities. "The cups of tea around the table might be different, green tea as opposed to a strong milky cuppa; the crops might be different, gac fruit as opposed to wheat or canola; and the hats are contrasting, conical hats instead of the wide-brimmed hat of Australia. But when it comes to being proud of what they do, how they do it, wanting to improve and wanting the best for their families, then it's all the same," Melanie says on her online blog.

Policy Advisory Council tours Victoria

CANBERRA: ACIAR's Policy Advisory Council recently toured rural Victoria as part of the annual council meeting in Australia. The program began in Canberra with a formal Council meeting and a dinner with the Honourable Alexander Downer MP, Minister for Foreign Affairs.

Partner-country council members at the meeting included Dr Patricio Faylon (Philippines), Mr Jia Jingdun (China), Dr Nguyen Van Bo (Vietnam), Dr Achmad Suryana (Indonesia), Dr Mangala Rai (India) and Mr Brown Bai (Papua New Guinea).

The Council, which advises the Minister with regard to agricultural problems of developing countries and agricultural research programs and policies, provided input on country research priorities and strategic issues for inclusion in the 2007–08 Annual Operational Plan.

The Council then travelled to Victoria, where they visited the Victorian Chief Veterinary Officer Unit and the Australian Animal Health Laboratory to look at animal pest and disease research and development, and disease monitoring and emergency control.

Members also visited the Wimmera and Mallee regions and the irrigation area around Mildura, and met with Australian researchers, project leaders and innovative producers and producer groups. These included the Grains Innovation Park in Horsham, the Wimmera Catchment Association, the Birchip Cropping Group, and the Riverlink group.

Beer waste irresistible to fruit flies

HANOI: Fruit flies, the scourge of the Vietnamese fruit industry, are set to be more tightly controlled with the opening of a new commercial protein-bait facility at the An Thinh Brewery near Hanoi in May. A new technique for luring mature flies to an insecticide has been developed after six

Time for celebration: the launch of the new protein-bait facility at An Thinh Brewery in Hanoi, Vietnam.

years of research in Vietnam by Australian and Vietnamese scientists, using the yeast waste from beer production.

The pests can cause losses of up to 100% in peaches, rose-apples, dragon fruits, mangoes, lychees, persimmons, grapefruit, oranges and many other fruits and vegetables across Vietnam, reducing the income of already poor farmers.

The An Thinh Brewery facility is the second to produce fruit-fly bait from the yeast waste. The first facility, at the Foster's brewery in southern Vietnam, has been selling pesticide-laced protein baits since June 2006, but it cannot produce enough to meet the rising demand for the product in the north of the country. Using the protein baits as a control method for the fruit fly reduces the need for large-scale use of pesticide sprays, which can contaminate fruit and reduce their value.

At the facility launch His Excellency Mr Bill Tweddell, Australian Ambassador to Vietnam, said: "Vietnam's fruit farmers now have a new source of low-cost, safe, environmentally friendly product to control fruit fly, to increase fruit yields and fruit safety." It is hoped the increase in fruit yields and quality will contribute to income generation for poor farmers, in another step towards poverty alleviation in Vietnam.

First ACIAR graduate trainee gets a start

CANBERRA: ACIAR's first graduate trainee, Meredith Errington, joined ACIAR in February 2007 as part of the new graduate trainee program.

This program, established last year by ACIAR director Mr Peter Core, awards one traineeship each year to a young Australian graduate as an opportunity to become exposed to international agricultural research within the broader context of Australia's aid program.

Meredith is working with ACIAR's research program managers, the Communications Unit and the director to receive on-the-job training in project development and monitoring, drafting and production of corporate documents, and the preparation of discussion papers on emerging issues relevant to ACIAR's planning.

Meredith completed a Bachelor of Science in Agriculture (Hons) in 2006 at the University of Sydney. Her Honours thesis was on cotton nutrition and the efficacy of foliar fertilisers. Her project results will be presented at the World Cotton Conference in Texas later this year. Next year, she plans to start a PhD on cotton physiology and internal distribution of nutrients.

Meredith said, "I hope to work in agricultural research and extension in developing countries in the future. Working at ACIAR for a year before further study was an excellent opportunity for me to have some experience in this area and to learn about research collaboration between Australia and developing countries."

Meredith Errington: ACIAR's first graduate trainee.

Order of Australia to Dr Tony Fischer

CANBERRA: One of ACIAR's recently retired program managers, Dr Tony Fischer, has been awarded an Order of Australia as part of the Queen's Birthday 2007 Honours List.

Dr Fischer is widely acknowledged as one of the world's leading wheat scientists as well as one of the world's leading plant physiologists.

Dr Tony Fischer

ACIAR director Mr Peter Core congratulated Dr Fischer on his award. "Tony has had a career-long commitment to the application of agricultural science to improving food supply in developing countries over many years," he said.

"In his role at ACIAR, Tony used his extensive network to create linkages of people and ideas, which has led to much fruitful collaboration within our partner countries and Australia.

"Through his close connection with the International Wheat and Maize Improvement Centre (CIMMYT), he has also provided immense benefits to the Australian wheat industry and has promoted CIMMYT as the main supplier of germ plasm to the industry," Mr Core said.

Congratulations Misha

HANOI: In March 2007 the Vietnamese Ministry of Agriculture and Rural Development (MARD) awarded Misha Coleman, then ACIAR's manager in Vietnam, the Government of Vietnam's Medal for the Cause of Agriculture and Rural Development.

The award recognised Ms Coleman's significant contribution to the collaboration between Vietnam and Australia on agricultural research for development under the auspices of ACIAR's program.

Misha joined ACIAR in June 2004 after having worked in Cambodia and Vietnam in the non-government sector and with AusAID in Canberra and Bougainville. She left ACIAR in April 2007 to further her career by joining World Vision Australia in Melbourne as policy adviser to the chief executive, the Reverend Tim Costello.

As ACIAR's manager in Vietnam, Misha was a proactive and enthusiastic supporter of ACIAR's work and an excellent ambassador for the Vietnam–Australia partnership in agricultural research. Examples include her excellent work in facilitating the commercialisation of the SOFRI–Foster's protein-bait product in South Vietnam and the formation of a joint stock company in Hanoi to construct a new protein-bait facility in the north.

Biofuels Conference

CANBERRA: The ATSE Crawford Fund's 2007 annual conference will be held on 15 August 2007 in the Theatrette, Parliament House, Canberra. This year's title is 'Biofuels, Energy and Agriculture—Powering Towards or Away from Food Security'. Free online registration and further information are available at **www.crawfordfund.org**, **03 9347 8328** or by emailing **crawford@mira.net**

PNG postgraduates pass with flying colours

Standing proud: James Butubu, Brian Takaboy, Amos Topi Uriningi, Ronnie Datoana, Gure Tumae, Peter Amatus (not ACIAR-sponsored), Professor A. Halim, Dr Jacqui Wright, Nicholar Boas, Bandy Keponge Yombo and Densley Tapat at the April 2007 graduation ceremony at Unitech, PNG.

LAE: Nine Papua New Guinean postgraduate students were awarded their Masters and Diploma degrees in agriculture at a ceremony held on 20 April 2007 at the University of Technology (Unitech) in Lae, Papua New Guinea.

Under an ACIAR scholarship scheme, the students completed postgraduate coursework and research projects linked to ACIAR activities in PNG, ranging from DNA fingerprinting of cocoa diseases to developing new fish and pig feeds.

The three-year program is the first of its kind for ACIAR. Students in the Agriculture, Forestry and Applied Science departments at Unitech are provided with a stipend, research funding and administration costs, with assistance from senior University of Queensland staff. Twelve students have graduated in the past two years, with six more set to don their robes next year. All nine graduates this year have found employment in PNG's agricultural sector and are working with local organisations to improve food security and productivity in the region.

Amos Topi Uriningi, one of the recipients of the ACIAR scholarship, said after graduation: "We are grateful to ACIAR for its support. I hope ACIAR will continue this endeavour for manpower development of PNG in the coming years."

John Dillon Fellows meet the Minister

Ms Ismayanti, from Indonesia's Ministry of Marine Affairs and Fisheries, receives her John Dillon Memorial Fellowship Award from Minister Downer.

CANBERRA: Seven new John Dillon Memorial Fellowship awardees toured Australia for five weeks in February and March 2007, visiting various host organisations, attending formal training in research management and visiting ACIAR in Canberra, where they also met the Honourable Alexander Downer MP, Australian Minister for Foreign Affairs.

The awardees include scientists from across Asia and the Pacific who are currently participating in, or have recently participated in, one of ACIAR's research projects and who are demonstrating potential as future research managers and leaders.

Their areas of expertise range from forestry management to water and agroclimatic research, areas in which training and resources from scientists in Australia could prove invaluable.

The aim of the John Dillon Fellowship is to provide developing-country scientists with an opportunity to extend their leadership and research capability through exposure to Australian agricultural technologies and research institutions.

Indonesian priorities

JAKARTA: ACIAR senior staff, representatives from the Indonesian Government and representatives from research, farming and extension agencies met in Jakarta in late February 2007 to discuss priorities for the collaborative agricultural research program between Indonesia and Australia. A shift in focus towards the development of integrated agribusinesses across a range of agricultural disciplines, rather than single-faceted production research, will be at the forefront of the newly developed set of research priorities.

These will be spread across seven key subprograms, emphasising animal health and production, crop protection, forestry, fisheries and agricultural policy research and will be used by ACIAR as a framework for development of research activities in Indonesia until 2011.

Farewell John Fryer

It is with great sadness that ACIAR records the passing of Dr John Fryer, Forestry Research Program Manager from 1994 to 2004.

In his ACIAR role, John made a significant contribution to the development of forestry in the Asia–Pacific region. In particular, he oversaw the continued development of eucalypts and acacias as major elements of plantation forestry, and the introduction of approaches to managing pests and diseases and improving utilisation of these species. ACIAR's contributions to the Asian eucalypt and acacia plantation programs, and the industries now based upon them, have been independently assessed as among ACIAR's most effective international development activities, and John was a major catalyst.

An affable man with an easygoing but effective manner, John made many friends among Australian and international partner agencies. He had a strong commitment to development and, at the time of his death, had almost completed a two-year period as a volunteer adviser to the Forest Science Institute of Vietnam. His achievements in mentoring young Vietnamese forest scientists were very evident and much appreciated.

John was a true gentleman, generous and patient. He will be greatly missed by the ACIAR community, by his many friends in Australian forestry, and internationally.

NEW APPOINTMENTS

ANNI SUGIONO

Anni Sugiono is ACIAR's new accountant, responsible for external reporting. She has a Masters of Accounting from the University of Melbourne and is currently enrolled in the CPA (certified practicising accountant) program. She also has a certificate in information systems and is a Microsoft Certified Professional.

CATHY PIANGA

Cathy Pianga joins ACIAR from AusAID, where she was senior programs officer for rural development and private-sector growth, and managed the ACIAR–AusAID Record of Understanding. Cathy was instrumental in planning and design of the Agricultural Research and Development Support Facility (ARDSF), which is concerned with capacity building for agricultural research and development institutions in PNG and dissemination of demand-driven adaptable agricultural research products. Cathy hopes ARDSF will provide a cutting-edge link between ACIAR and AusAID.

Cathy holds a Bachelor of Arts degree in public policy and international relations, and a Postgraduate Diploma in economic policy analysis. She brings to ACIAR a wealth of knowledge and experience in the development sector of PNG, having worked with the Department of National Planning and Monitoring and the private sector, including Ok Tedi Mining Ltd.

GEOFF MORRIS

Geoff Morris replaces Misha Coleman as ACIAR country manager for Vietnam, based in Hanoi. Geoff has a combined Bachelor degree in Science and Forest Science from the University of Melbourne, and a Master of Business Administration from the University of New England. Geoff has a wide range of experience in forest and land management, project coordination and community development. Geoff worked with Forestry Tasmania in strategic planning operations and district management roles. He also worked through the Australian Volunteers International program as a senior adviser to a Vietnamese Government research centre and non-government organisations in forestry research, forest management and community development.

MARA FAYLON

Ma. Rassel 'Mara' Faylon is ACIAR's new assistant country manager for the Philippines. She previously worked for the Philippines' Department of Science and Technology, where she gained vast experience in providing support services. Mara recently completed her Masters in Management from the University of the Philippines Los Baños, the same institution where she obtained her Bachelor of Science in biology.

NEW PROJECTS

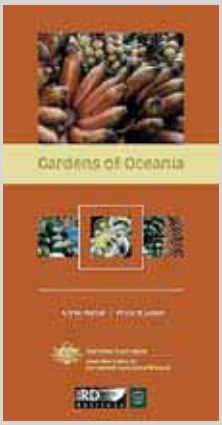
AH/2006/050	Control and characterisation of highly pathogenic avian influenza strains in poultry in Indonesia
AH/2006/077	Identifying research priorities for the development of the beef industry in Cambodia and Lao PDR with special reference to animal health interventions
AH/2006/155	Vaccine business development in Lao PDR
AH/2006/163	Assessment of zoonotic diseases in Indonesia
AH/2006/164	Future directions for animal health services in Indonesia
ASEM/2005/124	Extension approaches to scaling out livestock production in northern Lao PDR
ASEM/2006/023	Re-commercialisation of the PNG pyrethrum industry and improving harvested yields in Australia
CP/2005/075	Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of NAD province, Indonesia
CP/2006/063	Integrated pest management for Finschhafen disorder of oil palm in Papua New Guinea
CP/2006/083	Effective phosphine fumigation—technology transfer
CP/2006/084	Targeting crop protection research and development (R&D) towards social change amongst ethnic minority communities in central Vietnam
CP/2006/113	Scoping study to review the role of women and assess constraints in the production of indigenous Vietnamese vegetables
CP/2007/187	Technical support facility for commercialisation of protein-bait production in north Vietnam
CP/2007/211	Scoping study to identify research and implementation issues related to management of the brown plant-hopper/virus problem in rice in Vietnam
FST/2004/050	Value-adding to PNG agroforestry systems
FST/2004/061	Assessment, management and marketing of goods and services from cutover native forests in Papua New Guinea
FST/2005/100	Value-adding to Lao PDR plantation timber products
FST/2005/177	Improving economic outcomes for smallholders growing teak in agroforestry systems in Indonesia
FST/2006/118	Sandalwood inventory
HORT/2005/142	Improving mandarin production in Bhutan and Australia through the implementation of on-farm best-management practices
HORT/2005/160	Increasing citrus production in Pakistan and Australia through improved orchard management techniques
HORT/2006/055	Developing the ornamentals industry in the Pacific: an opportunity for income generation
HORT/2006/106	Screening and field trials of high-carotenoid sweet potatoes in Solomon Islands and PNG to improve human vitamin A status
HORT/2006/108	The potential for tropical fruits production in Tonga—a feasibility and constraints analysis
HORT/2006/111	Managing trade risks arising from the use of crop protection chemicals in horticultural crops in the Philippines and Australia
HORT/2007/210	Detection surveys for mango seed and pulp weevils in Sarangani and Davao del Sur, Mindanao, Philippines
LPS/2005/063	Improving the competitiveness of pig producers in an adjusting Vietnam market
LPS/2006/005	Evaluating strategies to improve calf survival in West Timor villages
LWR/2005/146	Expanding the area for Rabi-season cropping in southern Bangladesh
SMAR/2006/003	Integrating forage legumes into the maize cropping systems of West Timor
SMAR/2007/013	Opportunities to use cocoa pods and forages to address feed gaps in the dry season in South-east Sulawesi
SMAR/2007/197	Scoping horticulture projects in eastern Indonesia (passionfruit, cashews and tropical tree crops)
SMAR/2007/200	Securing the profitability of the Toraja and Flores coffee industries
SMCN/2006/013	Increasing food security and farmer livelihoods through enhanced legume cultivation in the central dry zone of Burma
SMCN/2006/031	Analysis of nutritional constraints to cocoa production in PNG

NEW PUBLICATIONS

MONOGRAPHS

Guidelines for surveillance for plant pests in Asia and the Pacific [Indonesian translation]

This is the Indonesian translation of Monograph 119, a manual that aims to assist plant health scientists to devise surveillance programs and to transmit specimens to the laboratory for identification and preservation. *Teresa McMaugh, Indonesian translation by Andi Trisyono, 2007, ACIAR Monograph 119a, $40.00 GST inclusive (plus postage and handling)*

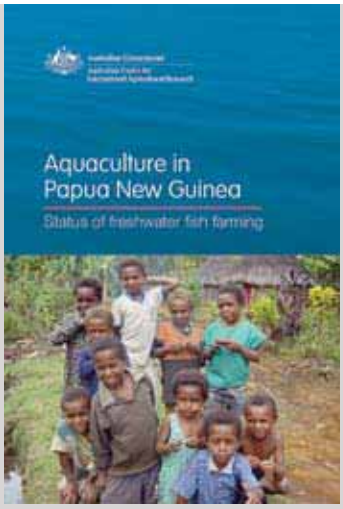


Gardens of Oceania

Gardens of Oceania summarises available knowledge about numerous food plants with commercial potential, in order to assure the development of an agriculture that can produce a sufficient amount to cope with formidable population growth while at the same time preserving the Vanuatu environment. It is an English translation from the French, originally published by IRD Éditions and CIRAD in 2003. *Annie Walter and Vincent Lebot, English translation by Paul Ferrar, 2007, ACIAR Monograph 122, $50.00 GST inclusive (plus postage and handling)*

Agricultural development and land policy in Vietnam [Vietnamese translation]

The main aims of the ACIAR project, which provided the information for this book, were to assess the impacts of the Vietnamese Government's new policies on agriculture and to provide economic models suitable for analysing policy reforms. *Sally P. Marsh, T. Gordon MacAuley and Pham Van Hung (eds), Vietnamese translation by Pham Van Hung, 2007, ACIAR Monograph 123a*



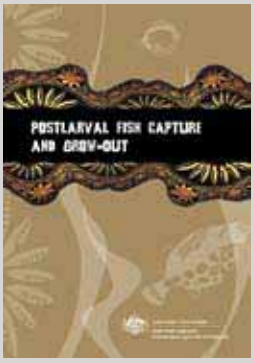
Aquaculture in Papua New Guinea: status of freshwater fish farming

This monograph summarises the results of an ACIAR project aimed to determine the status of inland aquaculture in PNG and prioritise the key researchable issues. It provides a comprehensive account of the history of aquaculture and fish stock enhancement programs in PNG, supported by a CD-ROM of 177 unpublished reports. *Paul T. Smith (ed.), 2007, ACIAR Monograph 125, $40.00 GST inclusive (plus postage and handling)*

Agricultural development and land policy in Vietnam: policy briefs

A bilingual (English and Vietnamese) version of Chapter 12 of *Agricultural development and land policy in Vietnam* (Monograph 123). These are the policy briefs developed through the ACIAR project 'Impacts of alternative policies on the agricultural sector in Vietnam'. *Sally P. Marsh, T. Gordon MacAulay and Pham Van Hung (eds), Vietnamese translation by P.V. Hung, 2007, ACIAR Monograph 126*

Postlarval fish capture and grow-out



This manual describes a new method for Pacific islanders to catch valuable fish and crustaceans for the aquarium trade. It explains the stages involved in setting up a 'capture and grow-out' operation and will help readers decide if this business is right for them and their community. *Cathy Hair, Regon Warren, Ambo Tewaki and Ronnie Posalo, illustrated by Kisi Mae, 2007, ACIAR Monograph 127, $15.00 GST inclusive (plus postage and handling)*

TECHNICAL REPORTS

Towards improving profitability of teak in integrated smallholder farming systems in northern Laos

Occurring naturally in Laos, teak is one of the world's finest timbers. The high sustained demand for teak wood, coupled with significant shortages of supply from natural forests, has stimulated the development of plantations in many tropical countries. This study examined the socioeconomic and technical constraints to the incorporation of teak planting into farming systems in northern Laos. *Stephen Midgley, Michael Blyth, Khamphone Mounlamai, Dao Midgley and Alan Brown, 2007, ACIAR Technical Reports 64, $27.00 GST inclusive (plus postage and handling)*

A review of animal health research opportunities in Nusa Tenggara Timur and Nusa Tenggara Barat provinces, eastern Indonesia

This report was commissioned to identify possible research opportunities in animal health (production) in Indonesia, consistent with ACIAR's mandate to alleviate poverty with a focus on village smallholders. *Bruce M. Christie, 2007, ACIAR Technical Reports 65, $20.00 GST inclusive (plus postage and handling)*

Modelling minimum residue thresholds for soil conservation benefits in tropical, semi-arid cropping systems

A targeted modelling approach was taken to investigate the benefits of conservation agriculture in the semi-arid tropics. Farmers may find partial retention of residues an acceptable compromise, enabling them to maintain some use of residues for livestock and divert the balance to soil fertility management and erosion control. *M.E. Probert, 2007, ACIAR Technical Reports 66, $18.00 GST inclusive (plus postage and handling)*

WORKING PAPERS

Economics and market analysis of the live reef-fish trade in the Asia–Pacific region

Live reef-fish are a high-income food product in many Asian countries. However, supplies are currently threatened from overfishing and unsustainable fishing practices in a number of countries. A key challenge for the future is to identify management arrangements that would effectively constrain fishing efforts in many wild-caught fisheries and stamp out unsustainable practices. *Brian Johnston (ed.), 2007, Working Paper 63, $45.00 GST inclusive (plus postage and handling)*

IMPACT ASSESSMENT SERIES

Impact assessment of capacity building and training: assessment framework and two case studies

Capacity building and training have long been recognised as an important component of most research-for-development activities. ACIAR and the ATSE Crawford Fund felt that it was time to undertake a detailed assessment of the options for more rigorously estimating the returns from capacity building and training. This assessment draws on literature and methodology reviews to suggest a framework for analysing the benefits of capacity building and training. This is illustrated through two case studies. *Jenny Gordon and Kevin Chadwick, 2007, ACIAR Impact Assessment Series 44*

Development of sustainable eucalypt plantations in China: a review

The forestry sector in China is a major contributor to economic growth. The development of fast-growing, high-yielding plantations for wood production has made a significant contribution to this sector. This report documents the story of Chinese forestry development. *John W. Turnbull, 2007, ACIAR Impact Assessment Series 45*

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