Country Profile

Vietnam

July 2004

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia's international development cooperation program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. ACIAR commissions collaborative research between Australian and developing country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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Preface

This is the first of a new publication series from ACIAR. The ACIAR Country Profiles are designed as a snapshot of the collaborative research being carried out between Australia and our key partner countries and regions. This publication contains short summaries of both bilateral and multilateral projects involving Vietnam that were active at 30 June 2004. At that time there were 19 active bilateral projects and 4 active multilateral projects, the latter being led by an international agricultural research centre. There were another 16 projects under development, many of which are expected to commence in 2004–05.

This publication also sets out the key outputs and outcomes from 13 projects that have been completed since July 2002.

In addition to these project summaries, the publication provides a record of the consultations that were held between ACIAR and Vietnam in February 2004 on the medium-term priorities for the joint program, an extract from our 2002–03 Annual Report covering Vietnam, and our near-term program as set out in the 2004–05 Annual Operational Plan.

Our intention is to produce a similar compilation of summaries each year and distribute them to key stakeholders in Vietnam and in Australia.

We hope you find the publication useful as a record of the ongoing progress and achievements of ACIAR's collaborative agricultural research and development program with Vietnam. For information on ACIAR's overall program, our website at www.aciar.gov.au is a key gateway to our operations.

Peter Core
Director

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July 2004

Vietnam report 2002–03

(extract from ACIAR Annual Report 2002–03)

Number of projects active in 2002–03	36
Bilateral country expenditure in 2002–03	$2 212 809
Bilateral country expenditure in 2001–02	$2 597 411
Bilateral country expenditure in 2000–01	$2 641 171

Position

Since the initiation of ACIAR's Vietnam program in 1993 a significant program in forestry, land and water resources, animal sciences, crop sciences, fisheries and postharvest technology has emerged. There has been an evolution from an emphasis on capacity-building to practical farmer and policy impact. Some new projects focus on extension or adaptation of outputs from earlier ACIAR projects in Vietnam and elsewhere in the region. Appropriate technologies arising from these projects are also being applied and capacity developed in R&D through the AusAID Capacity-building for Agriculture and Rural Development (CARD) program. ACIAR is also seeking greater involvement of the private sector and NGOs in projects, linkages with other donors and development of closer linkages between Vietnamese research and extension organisations.

Achievements

Many research activities in Vietnam have a strong emphasis on agricultural and natural resource policy. A project with the Hanoi Agricultural University is examining impacts of alternative agricultural policies on Vietnamese farmers. The research undertaken was drawn on by both sides in the recent Vietnam–US catfish anti-dumping debate. Investigations into the economics of developing reservoir aquaculture are examining a range of factors in the viability of this emerging industry. The extent of markets, impacts on prices, management to improve incomes, the best species economically, appropriate institutions and socioeconomic impacts are being examined, with the early data revealing this methodology should be appropriate to fish and other commodities.

A strategy for including environmental benefits and costs of alternative water allocation scenarios in the Mekong Delta region within an economic-hydrological model is being developed in conjunction with the International Food Policy Research Institute (IFPRI). In a separate project the application of irrigation main system operation modelling frameworks at three different sites improved operational rules for physically controlling water. This overcame existing system-specific constraints to achieve a more efficient use of water. At one site at Cu Chi a reduction in annual water use of about 98 MCM is possible, allowing excess supply to be diverted to Ho Chi Minh City with minimal impact on the supply security of the system. Subsequent field trials at other sites improved equitable supply to farmers.

The successful improvement of soybean varieties and their adaptation to Vietnamese conditions has moved a step closer through a project to identify suitable varieties. Two varieties with improved drought tolerance, through greater leaf survival in severe water stress, have been identified. A third variety has shown a 75 per cent increase in grain yield in the spring season, with increased yields also demonstrated in the summer and winter growing seasons. This variety has great potential for wide adoption in Vietnam.

Demonstrations with smallholder farmers provided evidence that agricultural by-products, particularly molasses, supported effective production from local cattle at a lower cost than other energy sources. The application of this knowledge and its transfer to a wider group of farmers is an objective of a new project to intensify smallholder beef production in central Vietnam. ACIAR’s work to adapt better pig varieties continues to deliver benefits to smallholder farmers. A fourth artificial insemination facility, jointly funded by ACIAR, AusAID and the Vietnamese Government, was opened in Quang Ngai in early 2003. This facility houses boars of Australian genetic origin, with semen distributed by facility staff and on-sold to private sector inseminators. The skills and knowledge developed in this project are now being widely applied in the commercial feedmill sector through the formulation of least cost rations.

Management of pest fruit flies has lacked an up-to-date survey of fly species of economic importance. Nine species have been identified as having pest status, and data on the hosts, ranges and distributions of these flies have been compiled. A large-scale plant for conversion of brewery waste to bait to attract and kill fruit fly has been installed at the Fosters Brewery at Tien Giang, with support from Fosters and Aventis. Pilot-scale batches are being produced and field tested in order to evaluate the best processing technique, and full-scale production for sale to farmers should commence soon. Field management research will commence as soon as the bait supply is available. A project developing crop disease management capacity has been working with farmers' advisers to provide plant disease information. This will strengthen advisory capacity, allowing farmers to better identify and manage diseases. An ACIAR/World Vision project led to strong adoption of community-based management of rodents in Binh Thuan province, Vietnam. An AusAID capacity-building project on rodent management in the Mekong Delta, based on outputs from ACIAR-funded research, has seen widespread adoption in five provinces in the delta.

Research has commenced in the northern mid-highland region to provide relevant advice and inputs in support of government development planning aimed at significantly increasing the fish yield from reservoirs. This would contribute to the availability of fish supplies at a price affordable to the rural poor, and provide income generation opportunities for communities living in the vicinity of the reservoirs. The project involves two distinct components: one focused on the culture-based fishery of 'farmer-managed reservoirs' and the other on reservoir capture fisheries in Vietnam. A survey of the supply and uses of feed fish (trash fish) in aquaculture activities has been completed in Vietnam. This completes the first step towards a larger, regional study on the uses of and problems associated with feed fish in aquaculture.

An *Acacia mangium – A. auriculiformis* hybrid has been shown to have superior growth characteristics to both parent species on many sites in Southeast Asia. The hybrid was artificially created as part of the project and methods developed for its vegetative propagation. The hybrid is now being widely spread throughout Vietnam, with almost 40 000 ha planted to date and a target planting of 150 000 hectares. Glasshouse trials in Australia of the mangrove *Avicennia marina* from different provenances have shown that plants maintain differences in morphological and growth characters when grown in the same environment. This demonstrates that these traits are genetically determined. It still needs to be determined what characteristics are considered desirable for reestablishment of new plantations in specific locations, and the extent to which these can be sought out in natural populations.

Assessment of the benefits and risks associated with use of composted green wastes, biosolids (sewage sludge) and organic wastes has begun to quantify and highlight benefits and potential food quality issues relating to heavy metals. Skills development for assessing nutritional and detrimental effects has emphasised quality control. Cost-effective contaminant monitoring of produce has been enhanced with the development of prototype residue test kits for aflatoxin B1, cyclodienes and DDT. Preliminary evaluation of the test kits commenced in laboratories and feed mills. Using skills acquired through ACIAR support, the Vietnamese team is developing test kits for other contaminant risks such as *Salmonella* in seafood and processed meats and shrimp virus diseases. Grain storage pest losses are being reduced as a result of surveys, demonstration trials and training which have addressed the different requirements for farmer storage, central grain stores and the animal feed industry. The commercial sector extensively uses the grain fumigant phosphine; however, work is examining methods that farmers can also safely apply.

Vietnam plan 2004–05

(extract from ACIAR Annual Operational Plan 2004–05)

Population	80.5 million
GNI per capita	AUD 792

Bilateral research expenditure	$m 2002-03 actual	$m 2003-04 budget	$m 2004-05 budget	$m 2005-06 indicative
Active projects	2.16	2.69	0.99	0.2
Committed funds for new projects			1.93	2.0
Projects under design			0.14	0.6
Available for new projects				0.1-0.3
Total	2.16	2.69	3.06	3.0-3.2

Strategy

ACIAR's Vietnam program strategy emphasises research to assist the enhancement of smallholder incomes through crop and livestock diversification within farming systems, and improving market access through the improvement of the safety and quality of agricultural products. Research will examine the comparative advantage of particular commodities for domestic and export markets and options for the development of rural agricultural enterprises including efficiencies of cooperative production and marketing. Fisheries research cooperation will focus on aquaculture, while forestry cooperation will address both conservation and utilisation, with an increased emphasis on higher-value products. Natural resource management research will emphasise sustainable cultivation systems for poor sandy soils in central Vietnam and acid sulfate soils in the Mekong Delta.

Key performance indicators

- Four new projects start with a central Vietnam focus, linking with research institutes in major cities
- Strong linkages between three projects on fruit production, crop protection and postharvest technology in the NW highlands of Vietnam
- Consolidation of AusAID-funded training of Vietnamese scientists in fish nutrition through the implementation of two new ACIAR projects
- Advancement of hybrid Acacia technologies into routine tree breeding programs
- Use of pesticide and mycotoxin tests for export crop certification
- Extension of disease management strategies for durians to farmers

Position

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

Some successes include improvements to rice−shrimp farming, integration of mangrove forestry and shrimp production, improvements to inland pond and small reservoir culture fisheries, introduction and dissemination of improved pig breeds, non-chemical rodent control in rice crops, fast-growing acacias, introduction of improved *Leucaena* for animal fodder, better irrigation management and control of citrus pests. Many of the technologies arising from these projects are being applied and capacity developed in R&D and extension through the AusAID Capacity-building for Agriculture and Rural Development (CARD) program, which commences a second phase during 2004–05.

Several new projects focus on extension or adaptation of outputs from earlier ACIAR projects in Vietnam and elsewhere in the region. Nevertheless considerable efforts are still under way to train scientists and to build up research institutions.
While most of ACIAR's program is currently based in greater Ho Chi Minh City and Hanoi because of the location of research institutes and policymakers and the national relevance of much of the portfolio, at the February 2004

country consultation it was agreed that the other geographic focus of the program should be central Vietnam, particularly central coastal regions.

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

During 2004–05, new projects are being initiated in selected areas of agricultural economics and development policy, animal sciences, crop protection, postharvest technology, fisheries, forestry and land and water resources management.

Indicative priorities

ACIAR has a program of consultations with partner countries on a four-year rolling basis to establish priorities for research collaboration. The most recent such consultation with Vietnam was held in February 2004; the full record of consultation is at www.aciar.gov.au under Partner country priorities/Vietnam. Because demand for new projects consistently exceeds available funds, it is expected that only a limited number of projects within the agreed areas of cooperation will be able to be supported.

At the February 2004 consultation, the issues below were given priority:

Agricultural economics and development policy

- Policy options for optimising future market-oriented crop (particularly rice) production in Vietnam, including understanding of the role of stakeholders in policy, production and markets
- Options for development of small-scale agro-enterprises in rural areas, including institutional and market chain analysis
- Assessment of and industry planning for possible impacts of trade agreements, particularly on the fisheries sector
- Policy options for cooperatives in agricultural (particularly fisheries) production and marketing systems to deliver improved and more secure returns to smallholders

Animal sciences

- Smallholder pig production systems including nutrition, housing, health and meeting market requirements
- Smallholder production of beef and small ruminants within crop–livestock systems including nutrition, genotype assessment and management
- Incentives and regulatory issues for improved animal waste management in peri-urban areas

Fisheries

- Cost-effective and environmentally friendly aquaculture feeds, with greater use of locally available nutrient sources
- Profitable environmentally responsible growout technologies for marine cage culture, and pond culture in sandy coastal areas
- Transferring existing knowledge from ACIAR fisheries projects in other countries, with particular attention to shrimp health

Crop protection and postharvest technology

- Enhancement of disease and pest diagnosis and management for perennial crops of central Vietnam
- Integration of practical fruit fly strategies with the management of other insect pests
- Development of pest survey manuals, compendia and databases to enhance quarantine capabilities
- Reducing postharvest losses and ensuring quality in smallholder systems for fruit, grains, legumes, animal feed and coffee
- Interventions to enhance the food safety and marketability of horticultural crops, particularly through supply chain analysis of tropical fruit

Forestry and natural resource management

- Development of technologies for fast-growing forest plantations for high and sustainable productivity, especially *Eucalyptus*, *Acacia* and *Pinus*, on degraded soils in northern and southern Vietnam

- Improvement of plantation wood processing efficiency, especially for small eucalypts and acacias through small-scale sawing, drying, preservation, and use of composites
- Use of indigenous tree species with high timber and non-timber forest product values and for rehabilitation of natural forests and conservation of biodiversity
- Sustainable cultivation techniques, including recycling of organic matter, to develop agriculture and agroforestry on poor sandy soils in central coastal Vietnam
- Development of land use practices to minimise the negative impacts to the environment on sandy and acid sulfate areas

Education and training

The majority of ACIAR-supported informal and postgraduate research degree training will continue to be delivered within the context of active projects. However, ACIAR will also support short-course training in selected areas, including: experimental design and statistical analysis; research management; research monitoring and evaluation; scientific proposal/grant writing and project design; biotechnology (particularly use of molecular markers); writing for scientific, extension, farmer and government audiences; and collection and analysis of market information.

Key program managers

Dr Ray Trewin, Agricultural Development Policy
Dr Bill Winter, Animal Sciences 2 (livestock production)
Dr Wendy Morgan, Crop Protection
Mr Barney Smith, Fisheries
Dr John Fryer, Forestry
Dr Ian Willett, Land and Water Resources
Dr Greg Johnson, Postharvest Technology

Country Manager

Ms Misha Coleman, ACIAR Country Manager Vietnam

Active projects
as at 30 June 2004

Bilateral

Multilateral

ADP/2000/018: The economics of developing reservoir aquaculture in Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Western Australia, Faculty of Agriculture, Australia
Project Leader	Dr Steven Schilizzi Phone: 08 6488 2105 steven.schilizzi@uwa.edu.au
Collaborating Institutions	University of Agriculture and Forestry, Vietnam Research Institute for Aquaculture No. 1, Vietnam Institute of Fisheries Economics and Policy, Vietnam Deakin University, Australia
Project Budget	$341,126
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Reviewers of the ACIAR-supported project 'Reservoir fishery development and management in the northern mid highland region, Vietnam' highlighted the urgent need to carry out socio-economic studies of reservoir fishery development in Vietnam. Although potential for poverty alleviation is high in the midland and upland regions, little attention has been paid to the economics of expanding production, and consequently hoped-for production targets are unlikely to be fulfilled. This project is focussing on small-scale reservoirs (including coves and cages in larger reservoirs), which have a higher economic potential than stock enhancement of the large reservoirs. Project researchers are seeking to address issues such as where to find markets for increased fish production in remote areas, how better farm management (like timing of stocking) can improve income, what fish species are economically suitable, and how property rights to water bodies are allocated and protected. Their answers are expected to give planners better insights into economic factors affecting returns to fisheries development; and help farmers/fishers to better manage their aquaculture systems.

Project progress

Year 1 (01/07/2002-30/06/2003)

Objective 1: The economics of cultured fish production in freshwater reservoirs
The goal is to assess how close, or how far, from an economic optimum current fishing systems are. Surveys were planned to collect data, and a multi-species bio-economic model will assess the economic viability of different cultured fish systems. The first wave of surveys is planned to provide data on the extent of variability in input and output factors, as well as in fishing system characteristics, such as purchasing or production of fingerlings, fish feeding if any, and harvesting techniques. The second wave will focus on understanding the day-to-day dynamics over time. As at end of March 2004, this first wave was nearly complete in the south, but has just started in the north. Surveys focus on nurseries providing fingerlings and on three types of fish for market operations—in cage culture, cove culture, and farmer-managed reservoirs. The second wave of surveys will only begin, as planned, after a thorough analysis of the first wave data is completed.

A specific sub-objective of Objective 1 is to develop (or adapt) a model for identifying the economically optimal management strategy of a cultured fishery, in terms of input levels, harvest levels, and species mix, given current and projected costs and prices. Work has started on inputs to the bio-economic model. Two research assistants have been hired. A review of the existing literature, including previous ACIAR and related reports, has been done, so as to determine the best modelling strategy. The first stage will be to model the larger farmer-managed reservoirs of the south, between 100 and 1000 ha in size. The smaller reservoirs will be dealt with later: they are more complex to model because of increased multi-species interactions in a more confined volume of water, and levels of oxygen, nutrients and other requirements may constrain the fishery.

Objective 2: Market development for value-enhancement of cultured fish
The goal is to identify how current markets and marketing arrangements constrain the economic potential of fish produce, and propose alternative arrangements that would increase the economic value per kg of fish produced. Surveys follow the same pattern as for production. The first group are nearly completed in the south but not yet in the north. Surveys target so-called 'middlemen' (often women) who sell fingerlings to, and market adult fish for, fishing operators. Analysis of the first sets of data has begun for the south.

Objective 3: Incentive structures for maximising the value of cultured fisheries for local fishing populations
The goal is to identify regulatory, policy and incentive constraints that limit the efficiency in production and marketing, and to propose alternative structures to enhance such efficiency. Data gathering strategy parallels that for production and marketing. Again, first surveys have been completed in the south but not in the north. Surveys have targeted local authorities at the Provincial, District and Village (Commune) levels, as well as the extension services at the Provincial level. Analysis of the first sets of data has begun for the south.

ADP/2001/066: Strengthening agricultural market information activities in Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Western Australia, Agricultural and Resource Economics, Australia
Project Leader	Associate Professor Michael Burton Phone: 08 9330 2531 Email: mpburton@agric.uwa.edu.au
Collaborating Institutions	Ministry of Agriculture and Rural Development, Vietnam Department of Agriculture, Western Australia, Australia
Project Budget	$399,574
Project Duration	01/01/2003 to 30/06/2005
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Vietnam faces many challenges in the area of agricultural marketing but lacks experience and capacity in market-based research. This project is developing a framework to analyse agricultural marketing issues. Researchers are describing (and quantifying) the current marketing channels for pigs, vegetables and canned fruit in Vietnam, and identifying the role of the public and private sectors in marketing these products. They are also comparing the experiences of public and private agricultural marketing services in China, Thailand and Australia with the situation in Vietnam. The researchers are working with the Information Centre for Agriculture and Rural Development (ICARD) (the market research and market information unit of Vietnam's Ministry of Agriculture and Rural Development) to determine how the Centre can provide ongoing market information services to these and other industries.

Project progress

Year 1 (01/01/2003-31/12/2003)

The main activities focused on assessing the capacity of ICARD in agricultural market research and refining the project objectives to best meet identified needs. This reassessment was conducted in consideration of parallel projects being funded by the French and Danish governments, and by AusAID. A review of market outlook services undertaken by government institutions in other countries was conducted, and in this context ICARD's current outlook activities were assessed and capacity-building needs identified. The French project is building capacity in short-term outlook yet the main capacity-building priorities identified by ICARD were in modelling the agriculture sector for medium-term outlook and policy analysis. A workshop aimed at identifying modelling training needs was conducted in Nov 2003 and a forward work program was developed.

Case studies: In the context of ongoing activities associated with the other donor projects at ICARD the choice of case studies for the current project was reassessed. The new AusAID CEG facility has resulted in a case study of the livestock sector being undertaken in collaboration with ICARD so the livestock marketing case study was deemed to be less urgent. An initial review of experience in the marketing of canned pineapple revealed that SPS issues were not of primary concern at the present time. For these reasons, and in order to benefit from the collaboration with scientists in ACIAR's Postharvest program, it was decided to focus the case study component on a single study, of stone fruit marketing in the northern provinces. This will allow a more in-depth analysis of economic issues affecting the supply chain (with the benefit of technical input from the postharvest study), whilst also allowing an analysis of demand/supply issues at the aggregate level. The case study presents a classic example of the tendency to emphasise increased production at the provincial level whilst not considering market opportunities for the produce. A field trip was conducted in Nov 2003 and it was planned to conduct field work in the coming 2004 harvest. However, depending on the timing of the related project, field work activities may be delayed until the following season to maximise project synergies. Mr Thang attended the ACIAR-funded workshop on Supply Chain Management in Bali.

International comparison: The main focus of the international component of the study was a field trip to China in October 2003. Three staff from ICARD (one funded by DANIDA) visited China with Dr Donna Brennan. The purpose of the visit was to study the structure and functions of agencies in China that have a similar mandate to ICARD. The market outlook and research activities undertaken by the Chinese institutions, and the structure and management of each agency, including personnel and financial management in a centrally planned economy, were examined. Agencies visited included the Ministry of Agriculture's Department of Market and Economic Information; the Chinese Academy of Agricultural Science's Institute of Agricultural Economics; the Research Centre for Rural Economy; and the Chinese Centre for Agricultural Policy. This agency was of particular interest because of its innovative design, which provided incentives to attract the best Chinese researchers; and because of its strengths in information management. CCAP maintains a database of farm costs and income (similar to ABARE) and has developed an agricultural sector model that is maintained and used regularly for quantitative policy analysis. The visitors reported back to the MARD about the design of this institution because the Vietnamese Government is interested in developing a similar 'economic think tank' for agricultural policy in Vietnam. In addition to agency visits, two field trips were undertaken to examine institutional innovations in marketing: these were to the Xinfadi Wholesale Market in Beijing and the One Dragon Head company (Hovill) in Gansu.

Also under the international comparison banner were literature reviews, one on marketing cooperatives and the other on contract farming, which were subsequently presented at ACIAR workshops. A seminar program on these topics is planned at ICARD in the coming year. In addition, a review of ICARD's outlook activities was undertaken, and compared to international practice.

AS2/2001/029: Development of a knowledge system for the selection of forages for farming systems in the tropics

Overseas Collaborating Countries	China, India, Indonesia, Pakistan, Philippines, South Africa, Vietnam
Commissioned Organisation	CSIRO Sustainable Ecosystems, Australia
Project Leader	Professor Bruce Pengelly Phone: 07 3214 2348 Email: Bruce.Pengelly@csiro.au
Collaborating Institutions	Queensland Department of Primary Industries and Fisheries, Australia International Livestock Research Institute, Ethiopia International Centre for Tropical Agriculture, Colombia University of Queensland, Australia
Project Budget	$837,717
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

In the developing world sown tropical forages can provide part of the feed base to support the expanding market for livestock products. Forages can improve feed quality and quantity in a range of farming systems. However, adoption has been limited for a number of reasons, including poor access to appropriate information. Much of the important information is fragmented, unpublished or published in media of limited circulation. This project is synthesising and interpreting what represents much of the accumulated information on species adaptation, use and management over the last 50 years from across the tropical world. The project team is combining all this information into one knowledge system (SoFT—Selection of Forages for the Tropics). The completed product will be a computer-based system that can be used to select 'elite' forage accessions tailored to specific farming systems and environments.

Project progress

Year 1 (01/07/2002-30/06/2003)

Objective 1: To develop a knowledge system for the identification of forages suitable for specified niches within smallholder farming systems.
There have been three major tasks associated with this first project objective:

1. Selection of the parameters and states to be used in the selection tool and the information to be provided in the major SoFT output, the fact sheets associated with each species.
2. The design of the selection tool (acting upon dot point #1)
3. Acquisition of information from experienced agronomists and from the literature.

The attributes to be used for forage selection and the key elements (criteria, and states for each criterion) of information to be recorded on database fact sheets were decided in a design workshop held in Bangkok in October 2002. That workshop was attended by the project management team plus forage agronomists from China and Thailand as well as Dr Peter Horne, CIAT, Laos. The key questions put to the workshop were:

- What overall design features need to be in the database?
- What forage selection criteria need to be in the database selection tool?
- What states need to be applied for each selection criterion?
- What material should be included in the database outputs?

The workshop provided excellent input into the design and development of the database. A critical outcome of the workshop was the decision that the final project product would feature static geographic information system (GIS) output rather than have a dynamic GIS facility. Any dynamic facility, while achievable, would have has very poor resolution because of the lack of detailed data

inputs available. It was thought that there was a risk that potential users of the SoFT product would tend to apply the outcomes despite the poor resolution with potentially poor selection being made. Rather, it was agreed to include in the SoFT database outputs from current GIS research being conducted by Dr Michael Peters and Ms Rachel O'Brien at CIAT.

Following on from the Bangkok meeting, the design of fact sheets and selection criteria has been finalised and these designs incorporated into the LUCID selection tool. This selection tool is now well into advanced development as demonstrated by its use in the August 2003 workshops to demonstrate the forage data and selections that are now possible as a result of the information obtained from the early data acquisition activities. The data input tool and a 'fact sheet builder'(which enables easier compilation of fact sheets within the predetermined template) have been developed. Mr Arturo Franco (CIAT) investigated options for the World Wide Web version of the database in a visit to Brisbane, Australia in March 2002.

The major task of assembling data commenced in 2002–03 with workshops of experienced agronomists held in Brisbane and Addis Ababa in March and May respectively. By June 2002 a total of about 100 species had been reviewed at these workshops with data and expert comments recorded on adaptation and utilisation of each forage.

In addition to the data assembly from experienced agronomists at these workshops, major reviews of a range of published literature have commenced in Australia and Africa (ILRI) with the aim of producing a bibliography for each species in the database. This literature review is aimed at both the traditional scientific literature and less well known literature such as annual reports from various research projects.

Objective 2: To promote the system within the 'communities' who are using tropical forages.
The major activities under this objective have been undertaken in parallel with the regional workshops. More than 40 agronomists have already attended project workshops in the first year. The project leader also visited FAO and demonstrated the LUCID SoFT prototype in October 2002.

Objective 3: To develop a strategy for maintenance and updating the knowledge system.
Discussions are currently under way between FAO and the project team about new options for maintenance of the database. It is hoped that FAO will take a lead role in partnership with CIAT to maintain the database. Dr Stephen Reynolds, FAO, Rome, appears keen to collaborate and have the database linked to the FAO databases.

AS2/2002/079: Utilisation of local ingredients in commercial feeds for pigs

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Animal Research Institute, Australia
Project Leader	Dr John Kopinski Phone: 07 3362-9404 Email: john.kopinski@dpi.qld.gov.au
Collaborating Institutions	Institute of Agricultural Sciences of South Vietnam, Vietnam Southern Sub-Institute of Agricultural Engineering and Post-Harvest Technology, Vietnam
Project Budget	$399,999
Project Duration	01/04/2004 to 31/03/2007
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Pig production in Vietnam is an important industry for smallholder farmers, who supply 80 per cent of all pigs. The long-term viability of production is threatened by the high cost of feeds, most of which are imported. These high quality feeds are likely to continue to rise in price. The use of cheaper local feedstuffs is a viable solution, but is limited by a lack of knowledge of their suitability for pigs. This project aims to bridge the gap by assessing locally available protein and energy sources as potential components of commercial pig diets. On-farm assessments and other extension activities will be undertaken to share the results with the commercial and smallholder sectors.

Project progress

First progress report is due in April 2005.

CIM/1995/130: Soybean variety adaptation and improvement in Vietnam and Australia

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	CSIRO Plant Industry, Australia
Project Leader	Mr Andrew T James Phone: 07 3214 2278 Email: andrew.james@csiro.au
Collaborating Institutions	Vietnam Agricultural Science Institute, Vietnam Institute of Agricultural Sciences of South Vietnam, Vietnam Thai Nguyen University, Vietnam James Cook University, Australia
Project Budget	$732,297
Project Duration	01/07/1999 to 30/06/2005 (Project extended from 01/07/2002 to 30/06/2003 and from 01/07/2003 to 30/06/2005)
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Soybean has the third highest priority for crop research in Vietnam after rice and maize. Soybean is seen as a major feed source for an expanding livestock industry as well as a boost for human food supplies. Yields in tropical Asia are low, and the major aim of this research in Vietnam is to introduce improved varieties and production methods, first for summer crops in the north and then for other regions and seasons. Good work has already been accomplished in Thailand, and this new project is extending that work, hoping to lift average yields from 1.0 to 1.5 t/ha, through introduction of improved varieties and the development and promotion of good agronomic practices. The project team is also determining the varieties most attractive to growers and best adapted to different locations.

Project progress

Progress to September 2003

This project has established formal links between the Vietnam Agricultural Sciences Institute, the Institute of Agricultural Science, Thai Nguyen University of Agriculture and Forestry and informal links with the Hanoi #2 Agricultural University, the Oil Plant Institute and Can Tho University in Vietnam, and CSIRO Tropical Agriculture/Plant Industry and James Cook University in Australia.

The thrust in Vietnam was to improve varieties and production methods for summer soybean production in the northern hill and mountain regions, which are the source of more than 40% of national production, in the Red River Delta which produces about 20% of the crop, mostly in winter, and in the upland regions of southern Vietnam, which produces about 20%.

There are several key elements to the project. The first was to introduce and evaluate elite varieties from the Australian program for yield and adaptation in Vietnam. Concurrently, physiological and agronomic research was undertaken to explore and where possible to minimise limitations to improving adaptation and increasing yield in Vietnam. The research in Australia complemented that in Vietnam, with applied varietal improvement emphasis on tropical adaptation, tolerance to weathering and food quality attributes. Basic research focused on strategies to broaden the gene pool, especially for tolerance to environmental stresses and use of the ‘long juvenile’ trait to extend duration without increasing photoperiod sensitivity.

The use of extreme short-duration varieties was confirmed as a key limitation to yield in the north of Vietnam. Hitherto, short duration has been necessary to achieve the low daylength sensitivity necessary for one variety to be adapted to the spring, summer and winter cropping seasons. The necessity for one variety to be reasonably adapted to all three cropping seasons was in turn required to ensure supplies of fresh planting seed, because of the short time that soybean seed remains viable under local conditions.

During the project, varieties were introduced to Vietnam with medium duration, but with appropriate daylength sensitivity that enabled successful cropping in all three seasons. The combination of varieties with high yield potential and medium duration led to increases in yield over that of check varieties of up to 98, 34 and 49 per cent in the spring, summer and winter seasons, respectively. As a result of these findings, it is likely that one or more lines introduced through the project will be released for commercial production in Vietnam.

The saturated soil culture technique for irrigation of soybean and intercropping soybean with paddy rice was also introduced and tested in the lowland conditions of the Red River delta. Yield increased by up to 250 per cent through the combination of this technology with introduced varieties with higher yield potential.

The research in Australia identified and introduced to the breeding program new sources of tolerances to cold, drought and pre-harvest weathering of grain. In a linkage with the national breeding program in Australia a new tropical variety, YY, was released for commercial production. New technologies to identify genes responsible for drought response and for culinary quality were also developed. For the first time, genetic material from the wild perennial relatives was introduced into soybean through somatic hybridisation.

Key outputs from the project include: improved varieties and agronomic management; enhanced understanding of constraints to wider adaptation and higher yields; and new techniques for enhancing the germplasm base available to breeders. In addition to the direct benefits from the project to both the Vietnamese and Australian researchers, the skill base of the Vietnamese researchers was improved through training visits to Australia, and the training of several postgraduate research students in Vietnamese universities. In addition, the project assisted two project staff to apply to undertake research in Australia and another to apply for higher degree studies in the USA .

CIM/1998/061: Coconut tissue culture for clonal propagation and safe germplasm exchange

Overseas Collaborating Countries	Indonesia, Papua New Guinea, Philippines, Vietnam
Commissioned Organisation	University of Queensland, School of Land and Food, Australia
Project Leader	Dr Steve Adkins Phone: 07 3365 2072 Email: s.adkins@mailbox.uq.edu.au
Collaborating Institutions	Philippine Coconut Authority, Philippines Cocoa and Coconut Research Institute, Papua New Guinea Research Institute for Coconut Palms, Indonesia University of the Philippines at Los Banõs, Philippines Oil Plants Institute of Vietnam, Vietnam
Project Budget	$711,309
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

In many countries coconut farmers suffer from decreasing farm productivity, largely due to ageing of palms and natural calamities such as pests and diseases, drought and typhoons. Varieties with higher yields and better environmental adaptations, and varieties that provide high-value products are needed to increase the income of coconut farmers and promote sustainable coconut production. This project is supporting collaboration between Australia, Indonesia, the Philippines, Papua New Guinea and Vietnam, designed to facilitate the safe transfer of coconut germplasm and the propagation of elite cultivars. Scientists are working to develop protocols for the rapid production of clonal, true-to-type cultivars and for improved embryo culture (regeneration of rooted plants from excised embryos). They are also developing techniques for genetic analysis to ensure that plants coming from a variety of sources are true to type. As the techniques develop they are being made available to germplasm banks in the partner countries.

Project progress

Year 1 (01/07/2002-30/06/2003)

Both the UQ and partner teams made good progress in the early phase of the project.

University of Queensland: Experiments on embryo transplantation, embryo culture, somatic embryogenesis and molecular analysis of tissue-cultured plantlets all took place at UQ in the first year.

- The first coconut seedlings, following embryo transplantation, have been successfully produced in the glasshouse. The transplantation technique used still requires improvements and is the subject of overseas collaborative work with the partners.

- Large numbers of zygotic embryos have been imported from the Philippines. They have been germinated in vitro and are being used to investigate improved methods of seedling growth, development and establishment. This work at UQ plans to examine the use of CO_2 enrichment for improved plantlet formation and greater soil survival.

- The UQ researchers have adapted their somatic embryogenesis protocol, previously developed for zygotic tissue explants, and are using it on explants from imported inflorescence tissues. The procedure showed a very low efficiency rate; medium additives such as coconut water and lauric acid improved the rate of success but no significant results have been achieved. From other studies, preliminary results indicate that abscisic acid (AbA) could improve the development of somatic embryos from inflorescence tissues.

- A protocol for DNA extraction and purification has been optimised for coconut tissues. Good visualisation of DNA can be obtained using approximately 15 to 20 ng of DNA per reaction. Other DNA samples have been imported from CICY, Mexico and are being analysed for the methylation polymorphisms that may exist between clones.

- The team at UQ hosted a meeting in March 2003 to launch a book published by ACIAR. Titled 'The Coconut Odyssey: The bounteous possibilities of the tree of life', it was written by Mr Mike Foale, CSIRO, an associate member of the UQ team.

Partners: In Indonesia, PNG, Vietnam and Philippines, the embryo culture research activities are still at an early stage of development. The present work aims are to prepare sufficiently large numbers of germinating embryos for their future work needs on improving seedling establishment rates.

- The early studies undertaken include those manipulating the culture medium to aid root system development, for producing a good shoot mass to root mass ratio, and those aiming to develop better acclimatisation steps. The germinating embryos, presently being established, take up to one year before they can be used in such experimentation. Therefore, the results will only become available in the second and third years of the project.

- In PNG, work on embryo quality has just been started while one partner in the Philippines has initiated work on somatic embryogenesis.

- Meetings at the collaborating partners' laboratories (PNG, Vietnam and the Philippines) have been undertaken to sharpen the focus of the project program.

- A new internet discussion group 'ACIAR coconut' has been established to facilitate information exchange among the team members involved in the project.

CIM/2001/027: Adaptation of low-chill temperate fruits to Australia, Thailand, Laos and Vietnam

Overseas Collaborating Countries	Laos, Thailand, Vietnam
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Maroochy Horticultural Research Station, Australia
Project Leader	Dr Alan George Phone: 07 5441 2211 Email: alan.george@dpi.qld.gov.au
Collaborating Institutions	Research Institute of Fruit and Vegetables, Vietnam National Institute of Plant Protection, Vietnam Southern Fruit Research Institute, Vietnam National Agriculture and Forestry Research Institute, Laos Department of Agriculture, Thailand
Project Budget	$388,981
Project Duration	01/07/2001 to 30/06/2004
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

This project is a new project in Australia, Laos and Vietnam, and an extension in Thailand of the original project CS1/1994/947. That project used a multi disciplinary, holistic approach to solving and developing sustainable temperate fruit industries in Australia and Thailand. The results highlighted a number of new issues to be addressed, particularly in the area of continued technology transfer and germplasm exchange to Thailand. Laos and Vietnam are keen to develop their fledgling temperate fruit industries. The transfer of fruit production technologies to upland regions of both Laos and Vietnam are government priorities and are being undertaken in the current project. The earlier project identified the key technical problems limiting further expansion of temperate fruits in Thailand and similar problems in Vietnam and Laos. These problems were: use of high-chill rootstock in low-chill regions, boron deficiency, severe water stress and lack of a suitable pest and disease spray programs. Four climatic zones for temperate fruit production in subtropical regions have been identified in Australia, Thailand and Laos: very low-chill, low-chill, medium-chill, and high-chill. In Vietnam, very high-chill regions also exist which could successfully grow Californian and other higher-chill varieties. In this project a wide range of species (plum, peach, nectarine, pear, persimmon) and varieties have been introduced into Vietnam and Laos to replace poor quality, locally-grown cultivars. The varietal base in Thailand has been expanded with additional species and cultivars introduced from Australia. There is a major focus on technology transfer, through definition of specific phenological cycles for different species grown in Laos and Vietnam; trialling of growth retardants and rest release chemicals; production of a decision support manual; further training through workshops, trial field plantings and demonstrations; and development of market plans for Laos and Vietnam.

Project progress

Year 2 (01/07/2002–30/06/2003)

Over 1300 stonefruit trees of 25 varieties of peach, plum, nectarine, persimmon have been sent to Vietnam and Laos. About 70% of these trees have now been field-planted at four arboreta sites in Vietnam and two arboreta sites in Laos with a wide range of chilling;

Vietnam is aiming to double its temperate fruit production area to 10,000 hectares within the next 5-10 years. In addition to growing low-chill temperate fruits, it has been observed that Vietnam can also grow high quality medium-chill cultivars of stonefruit. High quality medium-chill plum cultivars Black Amber, Simca and Fortune are performing well at Sapa. Under good management systems these varieties should produce late-season fruit in July and will complement the early-season production (March-May) from the lower-chill regions.

Local germplasm has also been identified in both Laos and Vietnam, which may be suitable for breeding because of its disease resistance and quality characteristics.

Non-astringent persimmon has been identified as a potential new commercial crop for Vietnam, Laos and Thailand. Better-adapted rootstocks have been identified in Vietnam. These appear to be better suited to the red ferralitic soils than the commonly used Australian rootstocks which have failed to establish quickly in Thailand on similar soil types. The cultivar Fuyu has been identified as the best variety for commercial production.

Important temperate fruit germplasm has been identified in Laos and Vietnam. Many local selections have resistance or tolerance to some of the major leaf diseases. Germplasm of two selections has been imported in Australia and will be incorporated into the low-chill peach-breeding program.

Commercialisation of temperate fruit production in Thailand is in progress. The peach cultivar Tropic Beauty has performed well and is being commercially produced by Hill tribe villagers near Ang Kang and Khun Wang. Recently established cool storage facilities in Ang Kang and the use of refrigerated trucks to transport the fruit to the larger cities of Chiangmai and Bangkok has ensured that high quality fruit is reaching the consumer. Agro-tourism is also being successfully developed in these regions, with temperate fruits being a major tourist attraction.

Key management practises for growing temperate fruits in Thailand, Laos and Vietnam have now been developed. The major pests and diseases identified are similar to those found in Australia. Senior research and extension staffs in the collaborating agencies in Thailand, Laos and Vietnam have been trained to identify the most serious pest and disease problems and to undertake appropriate control programs.

Extension officers and farmers have also been trained in pre-harvest production methodologies. Further training is need in supply chain management and quality assurance programs.

In Thailand and Vietnam, bait programs were highly successful in controlling the most serious pest, fruit fly.

Varieties introduced from Australia as part of the ACIAR project are receiving double the price of locally produced varieties, because of their higher quality. For example, nectarines, which no one had eaten before in Laos, were sold at 5000 k/kg in Nong Het and 8000 k/kg (about AUD1.20/kg) in Phonsavan. In Thailand, high quality Tropic Beauty peaches were retailing for AUD4/kg in the Chiangmai markets.

Nine training courses were conducted in Thailand, Laos and Vietnam in 2002–03 for local technicians, extension and research officers and farmers from Lao Cai, Son La and Ha Giang provinces in Vietnam, Nonghet province in Laos and Ang Kang, Thailand. Trainees were taught cultivation, orchard management and crop protection techniques for low-chill temperate fruit trees.

Year 3 (01/07/2003 – 30/06/2004)

The project was externally reviewed in April 2004, and will be extended in Thailand and Laos to consolidate and refine low-chill fruit production technologies in Laos and encourage their uptake in Thailand and Laos. Technology refinement and extension in Vietnam will be supported by ACIAR through a new project, PHT/2002/086 *Improving postharvest quality of temperate fruit in Vietnam and Australia*.

CP/1997/079: Integrated control of mango insect pests using green ants as a key element

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	Charles Darwin University, Faculty of Science, IT and Education, Australia
Project Leader	Associate Professor Keith Christian Phone: 08 8946 6706 Email: kchristi@ntu.edu.au
Collaborating Institutions	Prince of Songkla University, Thailand Southern Fruit Research Institute, Vietnam Department of Agricultural Extension, Thailand
Project Budget	$655,210
Project Duration	01/01/2001 to 30/06/2005 (Project extended from 01/07/2004 to 30/06/2005)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Mango growers use chemical insecticides to control mango pests, but with increasing environmental and economic problems. Traditionally in Asia the pests were kept under control by manipulation of colonies of predacious green ants in orchards, and this project seeks to reintroduce the old technology, with adaptive research to improve it. Following success with this approach in cashew plantations, this project is surveying mango pest populations in the presence and absence of green ants, undertaking field observations and laboratory experiments on interactions of the ants with mango insects, and conducting field experiments with transplanted ant colonies. Scientists are developing limited insecticidal treatments to control sap-sucking insects (which the ants encourage rather than attack), and also studying measures to prevent the ants stinging humans as the fruit is harvested. The research team is preparing instructional material (printed and video) and organising some farmer field schools.

Project progress

Year 3 (01/01/2003-31/12/2003)

All the identified outputs in this reporting period have been successfully achieved. The data obtained in the field monitoring and field experiments in 2003 in the Australian program demonstrated that similar yields and better quality of fruits were achieved from trees with weaver ants plus soft chemicals (51.8 fruits/tree and 62.6% of first class fruits) compared to trees protected by chemical insecticides (42.6 fruits/tree and 40.9% of first class fruits). Higher yields and better or similar quality of fruits were produced in trees with abundant weaver ants (45.8–61.4 fruits/tree and 58.4–68.5% of first class fruits) than in trees without weaver ants (51.5 fruits/tree and 39.8% of first class fruits). Sugar levels are higher in fruits from the weaver ant plus soft chemical treatment than in fruits of the insecticide treatment. Similar results were also obtained in the Prince of Songkla University program.

Weaver ants were effective in controlling the major mango insect pests compared to chemical insecticides and other ant species. However, the ants have a mutual relationship with scales and mealy bugs. The parasitic level of the plant hopper was higher in trees with weaver ants plus soft chemicals than in trees protected by chemical insecticides, which agree with the data obtained in 2002.

The soft chemicals, Applaud (0.03%), Potassium soap (1%) and White oil (2%) were effective in reducing mealy bug populations and are safe to weaver ants. A pure water spray at a rate of 2000 L/ha can reduce weaver ant activity by more than 70% for 50 minutes, which greatly reduces ant disturbance to people picking fruits. In Thailand, a long handle picking pole or net used with a shaking action reduces ant aggressiveness.

To stabilise weaver ant populations in mango orchards, data obtained by the collaborators at the Prince of Songkla University suggested that weaver ant populations have been more stable in the

mixed cropping orchard than in the monoculture orchard. Field experiments in the Australian component of the project were completed in November 2003, and the data analysis is in progress.

A preliminary integrated pest management (IPM) model constructed in 2002 has been tested in 2003, and a final model for Australian mango growers has been developed. Based on two years of data and on-going study, two preliminary models have been constructed for Thailand and Vietnam respectively.

The research group is actively involved in publications, communications, dissemination and extension activities. A video for Australian mango growers has been made. Videos in Vietnamese and Thai are under preparation. Posters and booklets are also under preparation.

CP/1998/005: Managing pest fruit flies to increase production of fruit and vegetable crops in Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Griffith University, Faculty of Environmental Sciences, Australia
Project Leader	Professor Dick Drew Phone: 07 3875 3696 Email: d.drew@griffith.edu.au
Collaborating Institutions	National Institute of Plant Protection, Vietnam Fosters Asia, Vietnam Southern Fruit Research Institute, Vietnam Aventis Vietnam, Vietnam
Project Budget	$603,978
Project Duration	01/07/2001 to 30/06/2005
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Vietnam needs comprehensive information about local fruit fly species in order to develop an export trade in fresh fruits and certain vegetables. Also, in northwestern Vietnam new plantings of temperate and subtropical fruits, established partly for development of poor areas and partly for opium substitution, are suffering close to 100% fruit fly damage. Farmers have become disillusioned and will abandon the development schemes unless solutions are found quickly. This project is ascertaining the economically important species of fruit fly and the host fruits of every species in each. It is also measuring damage levels of the major species and their seasonality, and introducing environmentally friendly, pre-harvest control by bait-spraying. Training programs are assisting with identification, biological studies, and development and implementation of field control campaigns. The project is running alongside an AusAID initiative that aims to implement field control of fruit flies, including the results of the ACIAR work.

Project progress

Year 2 (01/07/2002–30/06/2003)

Extensive collections of adult fruit flies collected from male lure traps and reared from host fruits (cultivated and wild) over 23 provinces covering north, central and south Vietnam have revealed that there are nine species of fruit flies are of economic importance to horticultural production and export trade in Vietnam. These are *Bactrocera dorsalis*, *B. carambolae*, *B. correcta*, *B. cucurbitae*, *B. diversa*, *B. latifrons*, *B. pyrifoliae*, *B. zonata* and *B. tau*. The species causing the greatest damage in north Vietnam are *B. dorsalis*, *B. pyrifoliae* and *B. cucurbitae*, whereas in south Vietnam the species causing greatest damage are *B. dorsalis*, *B. correcta* and *B. cucurbitae*. Crop losses ranging from 40 to 100% are being recorded in a wide range of fruits and vegetables when no control measures are applied.

To assist with field control studies, laboratory colonies (rearing on artificial diet) of *B. cucurbitae* have been established at the National Institute of Plant Protection (NIPP). Colonies of two other major pest species—*B. dorsalis* reared from litchi and *B. pyrifoliae* reared from peach are also being set up at NIPP. At the Southern Fruits Research Institute (SOFRI) colonies of pest species *B. correcta* and *B. dorsalis* have been successfully established. These laboratory colonies currently provide adult flies for laboratory and field testing of the new protein bait produced at Foster's Tien Giang brewery.

The production plant at Foster's Brewery at Tien Giang to process brewery waste into a fruit fly bait has been fully commissioned. Batches of protein bait produced at the plant are currently being evaluated by NIPP for field control of fruit flies infesting peach and bitter luffa, and by SOFRI on water apple and guava.

An extensive training program for on the biology and control of fruit flies for Provincial Plant Protection Department (PPPD) staff, as well as for farmers has been successfully implemented in various

provinces around Vietnam. Project staff from Brisbane initially ran a week-long workshop in June 2002 to train a core group of trainers from NIPP, SOFRI, PPD and selected universities in Vietnam. These staff members from NIPP and SOFRI have subsequently completed training a total of 177 PPPD staff as well as 1600 farmers from 16 provinces across Vietnam. The training was accompanied by the distribution of over 3000 illustrated brochures in the Vietnamese language on the biology and management of fruit flies, incorporating the new bait spray technology.

CP/2000/043: Huanglongbing management for Indonesia, Vietnam and Australia

Overseas Collaborating Countries	Indonesia, Vietnam
Commissioned Organisation	University of Western Sydney, Centre for Horticulture and Plant Science, Australia
Project Leader	Professor Andrew Beattie Phone: 02 4570 1287 Email: a.beattie@uws.edu.au
Collaborating Institutions	Gajah Mada University, Indonesia CSIRO Entomology, Australia Southern Fruit Research Institute, Vietnam National Institute of Plant Protection, Vietnam Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, Vietnam
Project Budget	$639,639
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Huanglongbing disease (HLB) (the Asian form of citrus greening) is the major constraint to citrus production in Asia, the industry having ceased completely in some areas when all trees died. In Indonesia the disease has spread from west to east as far as Irian Jaya, from where it may well spread into PNG and from there threaten Australia's citrus industry. Farmers have not readily accepted previous management strategies, which tended to be unreliable through lack of sufficient scientific knowledge. This project aims to provide the facts on which to base a sound strategy, focusing on the pathogen itself, the insect vector (the citrus psyllid) that transmits the disease and the interactions between the two. In Vietnam the French agency CIRAD is focusing on the pathogen and ACIAR is supporting the entomology and pathogen–vector relationships. In Indonesia ACIAR-funded scientists are surveying the distribution of the vector and its natural enemies, then comparing the natural enemy spectrum in Indonesia with that known from Vietnam and identifying potential natural enemies for a biocontrol program. They are also determining the possible role of petroleum spray oils in vector control.

Project progress

Year 1 (01/01/2003-31/12/2003)

The first annual planning and review meeting was held in Ha Noi, in February 2003. Experimental protocols were planned for most project activities after presentations from participants. Orchards were also visited at Cao Phong in Hao Binh province. Protocols were circulated for comment in May 2003 but progress during the year was hindered by travel restrictions.

In September/October 2003 Dr Andrew Beattie and Dr Paul Holford visited the Indonesian Botanic Gardens in Bogor and Gadjah Mada University in Yogyakarta. During this visit potential sites for field experiments were inspected and plans for constant temperature facilities required for other experiments were reviewed. Dr Paul De Barro (CSIRO) suggested modifications to the facilities when he visited Indonesia in December 2003 to plan experiments and visit field sites. Construction of the facilities has commenced. In late 2003 an entomologist (Dr Zamir Hossain) was appointed from January 2004, to undertake project activities in Indonesia, and to help coordinate other activities.

Dr Holford and Dr Beattie visited Vietnam in October 2003 to review project protocols and continue planning of experiments in Vietnam. Dr Beattie also discussed these plans with project personnel during other non-project visits to Vietnam. Dr Mabberley helped to prepare a list of plants (citrus and citrus allies) to test as hosts for huanglongbing and the Asiatic citrus psyllid (*Diaphorina citri*), and to resolve uncertainty about relationships between these plants—a vitally important issue for the assessments.

CTE/2000/165: Facilitating farmer uptake of ACIAR project results: World Vision collaborative program (Vietnam components)

Overseas Collaborating Countries	Laos, Thailand, Vietnam
Commissioned Organisation	World Vision Australia, Australia
Project Leader	Mr Graham Tardif Phone: Email:
Collaborating Institutions	World Vision of Vietnam, Vietnam Laos World Vision Foundation, Laos World Vision Foundation of Thailand, Thailand
Project Budget	$1,267,261
Project Duration	01/01/2001 to 05/03/2007 (Project extended from 01/01/2004 to 05/03/2007)
ACIAR Research Program Manager	Dr John Skerritt

Project background and objectives

The emphasis of this project is to increase the impact of ACIAR project results through provision of technologies arising from ACIAR projects, by interacting with World Vision (WV) projects operating in appropriate provinces/districts in partner countries. ACIAR entered into a Memorandum of Understanding (MoU) with World Vision for this purpose in February 2000, and this project comprises some of the major collaborative activities in SE Asia under this MoU. This project consists of a set of six collaborative initiatives between ACIAR and WV in three partner countries. In each case, the emphasis is on integration of results arising from a mature or completed ACIAR project activity (which would gain from farmer-level extension of the results) into an active WV project in particular provinces of an ACIAR partner country (which requires particular technology interventions) .

The Vietnamese components—*Rodent Control in Rice Crops Using IPM Techniques* and *Improvement of Soil Fertility in Bac Binh District, Binh Thuan Province, Vietnam*—utilise technologies developed in several current or completed ACIAR projects to assist in the 'technical underpinning' of a larger WV rural development project in Binh Thuan province of southern Vietnam. The rodent management component built upon 'Management of rodent pests in Vietnam' (AS1/1996/019) and 'Management of rodent pests in rice-based farming systems' (AS1/1998/036); WV Vietnam staff collaborated with National Institute of Plant Protection (Vietnam) staff as well as CSIRO Sustainable Ecosystems staff. The soil fertility management component built upon 'Management of phosphorus for sustainable food crop production on acid upland soils'(LWR1/1994/014 and LWR1/1994/704). WV Vietnam staff collaborated with National Institute of Soils and Fertilisers (Vietnam) staff with a small number of visits by the Australian collaborator from LWR1/1994/014.

Project progress

Progress to September 2003

The rodent control component has successfully demonstrated that the community level trap-barrier system (CTBS) for controlling rodents is viable and economic. While it is still to be seen whether farmers are willing to pay for the establishment and maintenance of the system, early indications are that in locations of reasonable community cohesion there should be no problem with a user-pays approach. The component has been asked by provincial authorities to expand the CTBS to all districts in the province. The technology has been packaged and the potential is there for WV to expand its application to all its Area Development Programs in Vietnam. CARE International has prepared a CD of the integrated rodent system for widespread distribution.

The soil fertility improvement component has clearly demonstrated significant yield benefits of changing fertiliser practice and variety selection in peanut production of infertile sandy soil. The component has involved about 200 farmers in the target area, and has the potential to continue identifying improved crop management techniques.

FIS/2001/013: Culture-based and capture fisheries development and management in reservoirs in Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Deakin University, School of Aquatic Science and Natural Resource Management, Australia
Project Leader	Professor Sena De Silva Phone: 03 5563 3527 Email: sena@deakin.edu.au
Collaborating Institutions	University of Agriculture and Forestry, Vietnam Department of Agriculture & Rural Industries, Fisheries Division, Vietnam Marine and Freshwater Research Institute, Australia Research Institute for Aquaculture No. 3, Vietnam Research Institute for Aquaculture No. 1, Vietnam
Project Budget	$382,060
Project Duration	01/01/2002 to 31/12/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Earlier ACIAR-supported research on reservoir fishery development and management in the northern mid-highland region of Vietnam produced outcomes that led to recommendation for further research in several key areas. This project is extending the work into these key areas. Scientists are looking at farmer-managed reservoirs, seeking to develop the best management practices. They are undertaking an economic comparison between raising fish fry to fingerlings in cages or ponds. They are also surveying four selected reservoirs to determine whether there are previously unrecognised fish species suitable for culture. The work on capture fisheries in medium to large reservoirs is designed to aid the Government of Vietnam in development of policies to optimise reservoir yields and build a sustainable enterprise for small farmers.

Project progress

Year 2 (01/07/2002–30/06/2003)

Farmer managed reservoirs: In north Vietnam, twelve farmer-managed reservoirs in Yen Bai Province and eight in Thai Nguyen Province were stocked in March 2002, using three species combinations, randomly distributed. Species ratios were decided upon on the basis of previous observations, and the market acceptability of the different species in the region. Prior to stocking a farmer meeting was held and consensus was reached with regard to the extent of supply of fingerlings from the project, which ranged from 0 to 100%, based on the socio-economic status of each farmer (or farmer group). After stocking, water quality parameters such as total phosphorus, nitrate, chlorophyll 'a', pH, conductivity and temperature were monitored monthly. The farmer lessees were trained to maintain records of all inputs (feed, manure, etc.) into the system and of fish harvested. The reservoirs in both provinces were completely harvested in March–April 2003, then restocked at the same densities in May 2003 (second cycle). .

In the central highland region an assessment (14 reservoirs) was undertaken to determine the suitability of six reservoirs for the program. On the basis of socio-economic status of the lessees, morphometry of the reservoirs, past usage for fishery purposes, seven reservoirs were selected for the study. However, stocking had to be postponed until November 2002 due to drought conditions in the region, and will be harvested in the next reporting period.

Large reservoirs: Visits to the 14 selected reservoirs were completed. During these visits available historical data on the fisheries, including yield, type and numbers of each type of gear used, number of fishers and morphometric parameters of each of the reservoirs were collated. In addition, extensive consultations with the current management teams were held and the existing structure for the management of each of the fisheries was obtained. The information gathered is being prepared as a component of the PhD candidature confirmation requirements of Bui The Anh, the principal

researcher on large reservoirs. In addition, the data on stocking and yield are being subjected to time-lapse analysis with a view to ascertaining the effectiveness of stocking. In the course of the visits to the reservoirs limnological data, total nitrate, total phosphorus, conductivity, pH, and chlorophyll ‘a’ were obtained. This information is being collected for each of the seasons, and will be utilised to determine potential relationships of limnological features to fish productivity. The digitised catchment map data of the individual catchments were obtained, and these data are being used to determine relationships between catchment land-use patterns and fish productivity.

It was also apparent that apart from finfish a major food resource that is exploited is the small shrimp species, *Macrobrachium nipponensis*, of which very little is known. Accordingly, the project will evaluate the extent of this resource, and its impact on the community in providing a livelihood from two selected reservoirs from July 2003 to July 2004.

FIS/2002/068: Improving feeds and feeding for small scale aquaculture in Vietnam and Cambodia

Overseas Collaborating Countries	Cambodia, Vietnam
Commissioned Organisation	Department of Fisheries, Western Australia, Fremantle Maritime Centre, Australia
Project Leader	Dr Brett Glencross Phone: 08 9239 8103 Email: Bglencross@fish.wa.gov.au
Collaborating Institutions	Can Tho University, Vietnam Royal University of Agriculture, Cambodia Lake Argyle Industries Pty Ltd, Australia Research Institute for Aquaculture No. 1, Vietnam Aquaservice, Vietnam
Project Budget	$711,460
Project Duration	01/01/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Geoff Allan

Project background and objectives

Small-scale aquaculture of freshwater species in the Mekong regions of Vietnam and Cambodia is an important source of potential income, constrained by costs associated with feed and feeding. Limited availability of ingredients often results in use of poor quality feed with low nutritional value, which limits production. This project aims to identify prospective feed ingredients based on availability, volume, composition and nutritional quality. Rice bran, plant meals and other potential ingredients are being surveyed for quality and quantity to develop improved diets. Another important objective of the project is to build capacity among nutrition researchers working to develop improved diets, and extension workers working to transfer the information to low-income farmers, to ensure that improvements will continue beyond the project's life.

Project progress

The first progress report is due in early 2005.

FIS/2003/003: Stock structure of two important Mekong River carp species (*Henicorynchus spp.*)

Overseas Collaborating Countries	Cambodia, Laos, Thailand, Vietnam
Commissioned Organisation	Queensland University of Technology, School of Natural Resource Sciences, Australia
Project Leader	Dr Peter Mather Phone: 07 3864 1737 Email: p.mather@qut.edu.au
Collaborating Institutions	Mekong River Commission, Fisheries Programme, Cambodia Living Aquatic Resources Research Centre, Laos Department of Fisheries, Thailand Research Institute for Aquaculture No. 2, Vietnam
Project Budget	$318,785
Project Duration	01/01/2004 to 31/12/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The fisheries of the Mekong River Basin are essential to the food security of around 60 million people in several countries. Recent efforts by those countries, coordinated through the Mekong River Commission, have seen substantial development in the basin, but development poses a long-term threat to its fisheries. Management of fish stocks is needed, but the complexity and diversity of species (around 1700) requires management based around discrete groups. In this project, molecular genetic techniques are being used to identify gene pools, and hence discrete groups in the various species. Initially this work is focusing on two economically important carp species to demonstrate the approach and build skills in fisheries management.

Project progress

The first progress report is due in early 2005.

FST/1994/019: Genetic diversity and propagation of mangroves

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	Southern Cross University, Centre for Coastal Management, Australia
Project Leader	Professor Peter Saenger Phone: 02 6620 3631 Email: psaenger@scu.edu.au
Collaborating Institutions	Royal Forest Department, Thailand Vietnam National University, Vietnam
Project Budget	$717,021
Project Duration	01/07/1999 to 30/06/2005 (Project extended from 01/07/2004 to 30/06/2005)
ACIAR Research Program Manager	Mrs Heather Crompton

Project background and objectives

Mangrove communities have been heavily exploited for their wood, and disturbed by other activities including aquaculture, mining, and disposal of chemical wastes. The seeds of most mangroves start to germinate while still attached to the mother tree; replanting to rehabilitate degraded mangrove areas presents difficulties because the survival of gathered mangrove seedlings is generally poor and replacement planting needs to take place over several years. Thus problems of seed collection, seed viability and storage have greatly limited the availability of mangrove germplasm and consequently inhibited genetic studies and the evaluation of different species. This project was established with Thailand to undertake molecular biological studies on genetic variation in mangroves, and Vietnam to develop methods for micropropagation of mangrove through tissue culture. It aims to develop the capacity to produce and disseminate high quality mangrove germplasm of known genetic lineage in sufficient quantity to meet replanting needs throughout the region.

Project progress

Outcomes to December 2002

After two and a half years excellent progress had been made in achieving the objectives related to the application of DNA marker techniques to the mangrove *Avicennia marina*. This research was conducted at Southern Cross University, and was given a head start when important groundwork for the molecular studies of genetic diversity in this species was initiated and supported by Southern Cross University in 1997. The results have been disseminated in several publications in refereed journals, and have raised important questions about population structure, mating systems and gene flow that are currently being addressed in Australia (*A. marina*) and Thailand (*R. apiculata*). In Thailand, the collaborators have succeeded in establishing new techniques of DNA analysis with support and training from Southern Cross University. The project has thus clearly contributed to building research capacity in Thailand.

Glasshouse trials of *A. marina* from different provenances have shown that plants maintain differences in morphological and growth characters when grown in the same environment. This is an important result as it demonstrates that these traits are genetically determined. It still needs to be determined what characteristics are considered desirable for re-establishment of new plantations in specific locations, and the extent to which these can be sought out in natural populations.

A major aspect of the project has been to develop micropropagation of mangroves using tissue culture techniques. However, it has become evident that mangroves (*A. marina* and *Rhizophora spp*.) do not respond well in tissue culture. Satisfactory progress has been made at Burringbar NSW and Yen Lap, Vietnam, yet much work remains ahead before routine and efficient micropropagation of desirable genotypes can be achieved.

FST/1998/096: Domestication of Australian trees for reforestation and agroforestry systems in developing countries

Overseas Collaborating Countries	Global including India, Indonesia, Laos, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Dr John Doran Phone: (02) 6281 8319 Email : john.doran@csiro.au
Collaborating Institutions	None
Project Budget	$2,094,461
Project Duration	01/01/2000 to 30/06/2004
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

In much of the developing world people face severe shortages of wood and other forest products. Many Australian tree species are widely grown in developing countries and can help to alleviate this problem. However, failure to use the best germplasm reduces the benefits that these plantations provide. This project builds on earlier ACIAR-funded research and aims to assist developing countries to achieve more effective use of Australian tree species. CSIRO scientists are providing seeds, information and technology to the collaborating countries, and identifying environmental and management factors necessary to improve seed yield and quality. The development of local supply bases of genetically improved seed in collaborating countries will ensure sustainability.

Project progress

Year 4 (/1/01/2003–31/12/2003)

As in previous years, seed supply, provision of technical advice and literature, and training continued to be a main focus of the project. Research seedlots with a total weight of 10.5kg valued at $25 000 were sent to a total of 25 customers in 16 countries during the year. During 2003, seed collections to support the project focused on *Eucalyptus camaldulensis*, with extensive field trips to collect natural provenance seed in western Victoria and Queensland. Additionally seed of several species, including *Acacia crassicarpa*, *A. mangium* and *E. pellita*, was collected from seed orchards established in a previous project cycle.

Written technical advice on species and provenance selection, improved seed production, silviculture and utilisation of Australian species was provided by project staff to client organisations in many countries worldwide, with Cambodia, China, Ethiopia, Ghana, India, Indonesia, Kenya, Niger, Rwanda, Tanzania and Thailand prominent.

FST/2000/003: Mixed species plantations of high-value trees for timber production and enhanced community services in Vietnam and Australia

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Queensland, Department of Botany, Australia
Project Leader	Associate Professor David Lamb Phone: 07 3365 2045 Email: d.lamb@botany.uq.edu.au
Collaborating Institutions	Forest Research Centre, Vietnam Queensland Forest Research Institute, Australia
Project Budget	$939,828
Project Duration	01/01/2002 to 31/12/2005
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Mixed species plantations are often promoted as a preferable alternative to species monocultures in reforestation, although there is little real evidence for or against their use. This project is investigating the potential in Vietnam and Australia to use mixed species (primarily native) plantations for production of forest products including fibres and foods as well for their contribution to broader environmental services such as improvement of soils, erosion and flood amelioration, and increased biodiversity. Scientists are gauging community attitudes to plantations of high-value species and identifying the geographic and socioeconomic niches where these plantations, particularly in species mixtures, are likely to provide increased benefits to rural communities. They are assessing earlier plantings of mixed species in both countries to determine productivity of forest products and provision of environmental services, relative to monocultures of the species in the mixtures. From this they will estimate the complementarity of various species and use this information to select species and combinations for further testing, having regard for the needs of rural communities in Vietnam.

Project progress

Year 2 (01/01/2003-31/12/2003)

Most of the work in Vietnam is being undertaken as a partnership between the Forest Research Centre (FRC) at Phu Tho, the Information Centre for Agriculture and Rural Development (ICARD) and the University of Queensland (UQ). Most of the work is necessarily new—field trials have only recently been established and surveys are still under way or have only recently been completed. The consequence of this is that little data are yet available.

The Introductory Conference in February 2003 was attended by about 100 participants, including representatives of the Ministry of Agriculture and Rural Development, the Forest Sciences Institute of Vietnam, the Forest Inventory and Planning Institute, Deans from the five Vietnamese Universities teaching forestry, FAO, the Asian Development Bank and the German, Dutch and Danish aid programs. The purpose of the Conference was to explain, at an early stage, to as wide an audience as possible the activities planned forthis project. It also aimed to promote a more general discussion on reforestation research activities in Vietnam in order to share knowledge and receive feedback, then to develop an informal network of reforestation researchers with whom the research group (FRC-ICARD-UQ) could interact in future. The project team has established linkages with projects being undertaken by the Forest Science Institute of Vietnam, Dutch Tropenbos and the Netherlands Development Organisation, and GTZ. Close contact is being maintained with the 5MHRP Secretariat.

A survey of 210 farmers in three provinces of northwestern Vietnam was undertaken to evaluate farmer attitudes to tree planning and ensure that silvicultural research undertaken by the project is relevant to the needs of these key stakeholders. Additional preliminary surveys of 14 sawmills at two sites were undertaken late in the year to obtain an alternative view of the value of the rural timber market in northwest Vietnam, including the species currently used and prices being paid. After initial training of FRC staff, 29 existing plantation sites were sampled to determine what species are being planted, how well they are growing, and how they are being managed. The sites included over 60 species. Trees in most sites were aged 15 years or less. This work is continuing in 2004.

Plantings of trials continued, so that researchers could assess the performance of high-value tree species and determine whether these grow best in mixed species plantations or in monocultures . Four trial designs have been used: monoculture, pair-wise mixture, simple intimate mixture, and species-rich mixture. Selection of species to use in the trials is continuing to be refined as new data are obtained from the survey work and other sources.

During the year FRC staff undertook a study tour to Australia to gain a better understanding of Australian approaches to reforestation and forest research. An Australian Youth Ambassador for Development (AYAD) at FRC undertook a study of soil fertility at FRC, and gave instruction in research methodologies. Two more AYADs will work with the project in 2004. Within Australia the work has been largely undertaken with the framework of the Rainforest CRC. This includes an evaluation of competition in multi-species plantations with the aim of identifying the attributes of complementary and non-complementary species. Work continued on a long-term (14-year) trial. When published, this work should act as a model for similar analyses in Vietnam.

FST/2003/002: Development and evaluation of sterile triploids and polyploid breeding methodologies for commercial species of Acacia in Vietnam, South Africa and Australia

Overseas Collaborating Countries	South Africa, Vietnam
Commissioned Organisation	University of Tasmania, CRC for Sustainable Production Forestry, Australia
Project Leader	Professor Rod Griffin Phone: 03 6226 7946 Email: rod.griffin@ffp.csiro.au
Collaborating Institutions	CSIRO Forestry and Forest Products, Australia Sylvatech Ltd, Australia University of Adelaide, Australia Forest Science Institute of Vietnam, Vietnam CSIR Environmentek, South Africa
Project Budget	$506,055
Project Duration	01/01/2004 to 30/06/2008
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Australian acacias are important plantation species for industrial and fuelwood production in many developing countries, growing well on degraded soils no longer suitable for agriculture. They are amenable to genetic improvement and have shown large productivity increases through selection and breeding, but in certain regions they can be serious weeds. Triploids (plants with three sets of chromosomes instead of two) in agricultural and forestry crops are usually sterile and this can have the advantages of increased productivity, absence of seed to cause weed problems, and suitability for genetic modification without risk of genetic pollution through uncontrolled outcrossing to non-crop plants. This project aims to develop triploid clones of four Australian acacia species and their hybrids for use in plantations in Vietnam, South Africa and Australia. The development of higher yielding, sterile acacias would bring benefits to smallholders on marginal land in a number of developing countries.

Project progress

The first progress report is due in early 2005.

LWR/1998/119: Impact of heavy metals on sustainability of fertilisation and waste recycling in peri-urban and intensive agriculture in Southeast Asia

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Mike McLaughlin Phone: 08 8303 8433 Email: mike.mclaughlin@csiro.au
Collaborating Institutions	Department of Agriculture, Thailand Asian Vegetable Research and Development Center, Taiwan University of Agriculture and Forestry, Vietnam National Institute for Soils and Fertilisers, Vietnam Queensland Department of Primary Industries and Fisheries, Australia Department of Natural Resources and Mines, Queensland, Australia Department of Land Development, Thailand
Project Budget	$1,012,730
Project Duration	01/07/2001 to 30/06/2005
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Earlier ACIAR-supported research revealed that in parts of Asia peri-urban areas used for crops such as rice, potatoes and peanuts are at risk of metal contamination. Contamination by metals has health implications but the more immediate economic impacts arise from non-tariff trade barriers related to product quality. This project is directed at the growing concern regarding the contamination of soils and crops in Southeast Asia. It is developing research capacity and laboratory facilities for the study of soil and crop contamination in Vietnam and establishing training and exchange programs for staff in all the collaborating countries. Scientists are determining maximum allowable concentrations of contaminants in soils of the region, based on their studies of the re-use of wastes on agricultural soils, contamination of produce and of the ecotoxic effects of contaminants on soil microbial processes. They are developing criteria to assess the suitability of different wastes and composts for re-use on soils, based on experimentation examining a wide range of industrial and urban wastes commonly used in peri-urban and intensive agriculture. The research includes strategies to minimise adverse impacts of contaminants in agricultural inputs to soils in these sensitive areas.

Project progress

Year 2 (01/07/2002-30/06/2003)

Personnel have been trained for laboratory and field operations of the project in Hanoi and Ho Chi Minh City. Two of the initial trainees have accepted offers to undertake postgraduate studies in Australia and Thailand. Their roles in the project will be taken over by staff who have had limited training in Australia, but have been trained thoroughly by the Vietnamese staff leaving the project. The project team is also planning to modify the project's initial plan and send Gillian Cozens back to Vietnam and Thailand to implement additional training. This training is intended to further develop analytical skills for the replacement staff and assist with data interpretation. Metal dose response analysis will be carried out by using a Microsoft Excel-based EC50 calculator, which has been developed in Adelaide as an alternative to the complex data analysis required for assessing and comparing toxic responses.

Baseline data for the concentrations of toxic metals in soils of Vietnam are 90% complete. Critical loads for metals (copper, zinc and cadmium) have been determined at the laboratory scale at all sites in Thailand, Vietnam and Australia, and are now being verified with field trials. All together, eight field sites have been established in SE Asia and 14 in Australia. All ACIAR-funded sites have been established in Australia in addition to two National Biosolids Research Program sites in Victoria, to

finalise the field site network of 16 in Australia. These field sites are ongoing, with 90% of the analysis done for the first season and many field sites currently in their second season of crop growth.

Metal concentrations in organic/green wastes and biosolids have been determined and field experiments are ongoing for the assessment of beneficial and detrimental effects from these wastes. Scientific criteria will be used to complete a preliminary ranking to determine whether wastes are suitable or unsuitable for continued use in intensive peri-urban agricultural systems, once data from the first two crops from field trials are analysed statistically.

Communication has involved keeping the appropriate government bodies informed of the aims and progress of the research program—directly (e.g. by inviting personnel to workshops and through personal communications) and indirectly (through publication in journals). Key scientists in each country have identified and fostered relationships with the appropriate government bodies to ensure the correct communication channels will be available when the data from the project are statistically analysed, baseline data and metal thresholds determined, and appropriate guideline values derived. Local growers at all sites have been interested in the field trials, but as yet no farmer field days have been conducted in Southeast Asia.

PHT/1998/137: Integrating effective phosphine fumigation practices into grain storage systems in China, Vietnam and Australia

Overseas Collaborating Countries	China, Vietnam
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Farming Systems Institute, Australia
Project Leader	Dr Patrick Collins Phone: 07 3896 9433 Email: pat.collins@dpi.qld.gov.au
Collaborating Institutions	Zhengzhou Grain College, China State Administration of Grain, China Guangdong Institute of Cereal Science Research, China Postharvest Technology Institute, Vietnam Chengdu Grain Storage Research Institute, China Ministry of Agriculture and Rural Development, Vietnam
Project Budget	$747,602
Project Duration	01/01/2001 to 31/12/2005 (Project extended from 01/07/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Phosphine is the major fumigant for stored grains in China, Vietnam and Australia, due to its low cost, ease of use and acceptance as a residue-free treatment. However in earlier project work scientists identified growing resistance to phosphine by grain pests as a major threat to its continued use. Thus this project is investigating technical innovations to enhance the efficacy of phosphine, characterising phosphine resistance in new strains of major pests, developing management strategies for a newly emerging pest (book lice, known as psocids), and continuing to monitor phosphine resistance levels in stored grain insects while formulating fumigation standards for China, Vietnam and Australia.

Project progress

Year 3 (01/01/2003–31/12/2003)

Objective 1: To formulate and verify national fumigation standards for China, Vietnam and Australia.

National standards for modern grain storages were established and published by Chinese State Administration of Grain. The standard includes all aspects of fumigation procedure including safety precautions. Field trials have been undertaken in China to provide information for the development of fumigation standards for older storages (generally poorly sealed) and bag-stacks under plastic sheeting. The latter have been undertaken in Guangdong Province where phosphine resistance levels are alarmingly high.

Vietnamese team members at Plant Protection Department (PPD—Hanoi) staff have completed a national survey of phosphine resistance in major pests of stored grain. Strongly resistant strains have been detected in populations of lesser grain borer (*Rhyzopertha dominica*). These will be used as the benchmark for setting national fumigation standards for Vietnam. Experimental flow-through equipment was successfully commissioned in the PPD lab in Hanoi April 2003. This equipment is being used to characterise local resistant strains as a pre-curser to establishing national fumigation standards. Early results indicate that resistance levels are as high as those experienced in Australia. Initial results from use of the flow-through equipment at PPD have shown that both the flat grain beetle (*Cryptolestes* sp.) and booklice (*Liposcelis* spp.) also have high resistance to phosphine.

In Australia draft label change has been prepared for submission to Australian registration authorities (APVMA).

Objective 2: To improve fumigation practice in China and Vietnam by undertaking training programs.

During 2003, project staff in China continued the training program for management and technical staff of Provincial grain bureaux and storages with the support of the State Administration of Grain.

The Vietnam Institute of Agricultural Engineering & Post Harvest Technology (VIAEPHT - Hanoi) have developed family level pest management systems for farmers. On-farm trials of their system (silo, dryer, botanical protectant) have demonstrated savings to the farmer of 8.6% of his gross income. Importantly, the system avoided use of phosphine and the potential of chemical residues. VIAEPHT staff have held two additional storage best management practice training courses for farmers in 2003. Storage of maize on cob is common in Vietnam but cobs are readily infested by insects and risk of aflatoxin contamination can be high. VIAEPHT have developed a special dryer for maize cobs and a 2-layer storage bag. The cob storage system is being trialled in the mountainous province of Ha Giang in the northwest.

Objective 3: To investigate potential innovations to enhance the efficacy of phosphine fumigation

In China research by scientists at the Chengdu Grain Storage Research Institute have defined levels of CO2 required for control of a wide range of storage pests. They also demonstrated the utility applying phosphine as a split application.

In Australia, researchers at QDPI have completed extensive experiments and field trials characterising the influence of fumigation temperature, phosphine concentration and exposure period on the effectiveness of phosphine against resistant *Rhyzopertha dominica* and *Sitophilus oryzae*. In addition, resistance to phosphine has been characterised in *Tribolium castaneum* and *Oryzaephilus surinamensis* – both resistances can be controlled with the newly developed protocols. Phosphine fumigations of grain in bag-stacks and in small bins generally result in exposure of insects to changing concentrations of gas rather than the more constant concentrations experienced in large storages. A series of experiments undertaken at QDPI have shown that the efficacy of changing concentrations of phosphine can be predicted from results from assays using constant concentrations.

Objective 4: To determine the key factors preventing effective control of psocids with phosphine

Students at Zhengzhou Institute of Technology have contributed an outstanding amount to the knowledge we have of psocid biology, ecology, distribution and resistance to phosphine. This work is a highlight of the project.

Because psocids are sensitive to changes in humidity, QDPI team members are studying the combined effects of temperature and humidity on phosphine toxicity. Results to date indicate that at any dose, phosphine will be more toxic at a combination of higher temperature and lower humidity.

Multilateral

AS1/1998/054: Poverty alleviation and food security through improving the sweet potato-pig systems in Indonesia and Vietnam

Overseas Collaborating Countries	Indonesia, Vietnam
Commissioned Organisation	International Potato Centre, Vietnam
Project Leader	Dr Dai Peters Phone: +51 1 3496017 (Peru) Email: d.peters@cgiar.org
Collaborating Institutions	Balai Penelitian Tanaman Kachang-Kachangan dan Umbi-Umbian (Balitkabi), Indonesia National Institute of Animal Husbandry, Vietnam South Australian Research and Development Institute, Australia Food Crop Research Institute, Vietnam Dinas Peternakan (Jayawijaya Livestock Office), Indonesia Research Institute for Animal Production, Indonesia
Project Budget	$1,253,608
Project Duration	01/01/2001 to 30/06/2006 (Project extended from 01/01/2004 to 30/06/2006 in Indonesia only)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

This project is examining the sweet potato/pig production system in a culturally sensitive and systematic way in Irian Jaya, Indonesia and in Vietnam, using an interdisciplinary approach. Papua New Guinea will be invited to attend coordination meetings and to participate where the research agenda match that country's priorities. Specific goals are to increase income through improved feed and pig management and to increase food availability and nutrition of sweet potato varieties—using both on-farm and on-station research. Specific tasks are to assess and analyse the two existing types of sweet potato-pig production system (traditional in Irian Jaya and transitional in Vietnam) among other sweet potato–livestock systems within household economies to ascertain the trend and relative importance of each system. Research should lead to improved sweet potato-based production and stable food and feed supply, with emphasis on dual purpose and forage feed varieties, and drought- or frost-resistant varieties. The project should also help develop improved and integrated sustainable transitional subsistence systems to enhance pig productivity and efficiency of production with an emphasis on marketability.

Project progress

Outcomes to December 2003

Socio-political turmoil in West Papua hampered project activities in the first year. Work was undertaken on sweet potato selection in Java, Indonesia and in Vietnam. When work finally commenced in West Papua it involved an extensive exercise of data gathering, surveys and field observations, yielding much information about the animal and crop production systems and the socio-cultural and belief systems of Bailem Valley communities in West Papua.

Pig diseases and management emerged as a more significant factor than expected, and ACIAR provided extra funds to extend the surveys. The surveys showed that internal parasites were the most important problem for pigs. The project scientists therefore devised a management plan for pig production, incorporating some elements of the traditional 'laleken' system that had previously been used to manage rotational grazing and isolation of dung, but had been abandoned when wood for construction became scarce. A modified design is being considered for trialling in an extension operation.

In north and central Vietnam, where the sweet potato–pig raising system is an important component of the domestic economy, the project should increase household incomes through increased starch and protein yields in sweet potato and improved pig growth. Farmer-to-farmer extension has already started in Vietnam, involving farmer-trainers who have attended workshops and distribution of a manual that arose from the project.

The project is being extended in Indonesia (mainly West Papua) for a further two years. Vietnam has already fulfilled its project objectives.

CIM/2000/002: Development of advanced technologies for germplasm conservation of tropical fruit species

Overseas Collaborating Countries	Malaysia, Philippines, Thailand, Vietnam
Commissioned Organisation	International Plant Genetic Resources Institute, Malaysia
Project Leader	Dr V. Ramanatha Rao Phone: +60 3 89423891 (Malaysia) Email: v.rao@cgiar.org
Collaborating Institutions	Griffith University, Australia Department of Agriculture, Thailand Institute of Agricultural Genetics, Vietnam University of the Philippines at Los Banõs, Philippines Universiti Kebangsaan Malaysia, Malaysia
Project Budget	$746,479
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Conservation of many tropical fruit species is often difficult or impossible by traditional methods as many species have recalcitrant seeds (they do not tolerate drying and so cannot be stored in the standard way). Other species may have no natural seed dormancy, their seeds may have only a short life span, or they may not produce any seeds. Conservation of genetic resources of these species is extremely important but efficient and appropriate methods for their long-term and sustainable conservation are not available. This project is developing new techniques to conserve the germplasm of selected tropical fruits and related species. The major objectives of the project are to develop cryopreservation methods (storage at ultra-low temperatures) for priority species, to develop alternative conservation and regeneration strategies, and to disseminate proven technologies to researchers and other users in the region.

Project progress

Year 1 (01/01/2003-31/12/2003)

The outputs expected for all three objectives in year 1 were fully achieved. The five partner countries are working on identified priority tropical fruits to develop new techniques to conserve germplasm. The initial stages of the project involved developing micropropagation systems for the identified crops (mango, papaya, Australian native fruits, *Nephelium*, citrus, persimmon, litchi and longan). Successful tissue culture systems were established to provide plant material for cryopreservation work.

Cryopreservation techniques such as encapsulation dehydration (ED), vitrification, new encapsulation-dehydration (NED) and slow freezing were attempted to conserve different plant materials. Developing-country partners were trained in using these techniques through a course organised at Griffith University, Australia in September, 2003. At the end of the course, each trainee developed a re-entry plan in line with project activities, to be implemented upon return to their institutions.

Initial work on cryopreservation of papaya, citrus, Australian native fruits (citrus and Davidson plum) showed promising results. Work on mango, persimmon, litchi and longan has progressed well in establishing micropropagation systems.

Alternative conservation strategies such as slow growth as well as storage of seed in liquid nitrogen were attempted. Positive results were obtained for papaya and citrus. Established micropropagation techniques were shared among partner countries working on the same crop to adapt to the different species that they are working on.

CIM/2000/039: Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems

Overseas Collaborating Countries	Philippines, Thailand, Vietnam
Commissioned Organisation	International Rice Research Institute, Philippines
Project Leader	Dr Thelma Paris Phone: (632) 845 0563 Email: t.paris@cgiar.org
Collaborating Institutions	Curtin University of Technology, Australia Khon Kaen University, Thailand Cuu Long Rice Research Institute, Vietnam
Project Budget	$496,764
Project Duration	01/01/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Migration of men from rural to urban areas in search of employment is common in many developing countries. Many smallholders rely on income from family members engaged in off-farm work. The impacts of migration on the balance between reduced productivity from labour losses and increased off-farm income compensating through increased purchases of inputs is unclear, especially impacts on women. By examining rice-based farming systems in Vietnam and Thailand, and various farming systems in Australia, the project aims to increase understanding of changes in rural agriculture resulting from migration, particularly the changing roles of, and constraints on, women running farms. This understanding will inform the development of strategies and policy options to address constraints to productivity, for dissemination to key stakeholders.

Project progress

The first progress report is due in early 2005.

SMCN/1999/003: Integrated nutrient management in tropical cropping systems: Improved capabilities in modelling and recommendations

Overseas Collaborating Countries	Colombia, Indonesia, Kenya, Philippines, Vietnam, Zimbabwe
Commissioned Organisation	International Centre for Tropical Agriculture, Laos
Project Leader	Dr Rod Lefroy Phone: +856 20 509863 (Laos) Email: r.lefroy@cgiar.org
Collaborating Institutions	International Centre for Tropical Agriculture, Colombia National Institute for Soils and Fertilisers, Vietnam CSIRO Sustainable Ecosystems, Australia University of Zimbabwe, Zimbabwe Kenya Agricultural Research Institute, Kenya Tropical Soil Biology and Fertility Programme, Kenya International Crops Research Institute for the Semi Arid Tropics, India Bureau of Soil and Water Management, Philippines Center for Soil and Agroclimate Research, Indonesia
Project Budget	$434,130
Project Duration	01/07/1999 to 30/06/2005 (Project extended from 01/07/2002 to 30/06/2005)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Farmers in the tropics rely to a large extent on organic inputs and biological processes for managing soil fertility, yet organics are not part of fertiliser recommendations. Because of the variable, but predictable, effect of organics on nutrient availability, links with models are essential. Another major gap in soil fertility recommendations for the tropics is that of phosphorus management. Soil phosphorus dynamics and indicators of phosphorus availability are complex, yet no crop or ecosystems model has adequately captured phosphorus dynamics for estimating crop (or ecosystem) production. The objective of this project is to use data from a range of sites in the tropics to test and improve the capability of the Agricultural Production Systems Simulator (APSIM) to predict the decomposition of various organic inputs, the dynamics of nitrogen and phosphorus in soil, and crop yields (including P-deficient situations). The project will be implemented through the Combating Nutrient Depletion Theme of the Soil, Water and Nutrient Management Consortium (SWNM) of the Consultative Group in International Agricultural Research (CGIAR).

Project progress

Outcomes to June 2003

Project progress was reviewed in April 2003. The project has produced refined and functioning manure and phosphorus modules for the APSIM crop simulation model. The review panel considered this was an impressive return on investment by ACIAR.

The project made use of a number of field experiments being run by collaborators, and while the resultant data sets were not ideal, the prototype MANURE and P modules of APSIM were tested and some adjustments made to the code of both to improve their performance. The practical application of the models was demonstrated through the generally good agreement between simulated and measured values. Some problems were found in the performance of the MANURE module, originating from the difficulty in estimating the various parameters that drive it.

The question as to whether the manure and P modules are at a stage where their development can rest is one that cannot be definitively answered at this stage. More testing is required, particularly concerning low-quality manures and low-P soils. The MANURE module may require more work on the other factors associated with low-quality manure that need to be measured in order to improve the capability of the module.

One constraint for the project was the incompleteness of data sets used for model testing, arising because the trials were not originally set up for the purpose of validating APSIM. To this end, project partners should place emphasis on refining the data collection protocols for the provision of Minimum Data Sets that are fully functional for crop modelling purposes, and that are relatively quick and cheap to collect in the field, and include these in the final technical report. This is a key step towards ensuring that expensive long-term field trials in the future can serve multiple purposes, including that of model validation. Adding value to the vast quantities of field data collected in the past through estimating missing data by various means should also be considered.

The project provided training and support for national collaborators in the use of APSIM for integrated nutrient management practices. The review panel recommended that this effort be supported over the short-to-medium term, to allow APSIM to be evaluated in a wide range of conditions in smallholder farming systems but particularly to allow the project team to start moving the model away from the laboratory into the field.

ACIAR Proceedings 114, *Modelling nutrient management in tropical systems* (edited by R J Delve & M Probert), contains the papers presented at the final meeting of all project participants in early 2003.

Concluded projects
1 July 2002–30 June 2004

Bilateral

Multilateral

ADP/1997/092: Impacts of alternative policy options on the agricultural sector in Vietnam

Overseas Collaborating Countries:	Vietnam
Commissioned Organisation	University of Sydney, Australia
Project Leader	Professor Gordon MacAulay Phone: 02 9351 2574 Email: g.macaulay@agec.usyd.edu.au
Collaborating Institutions	Hanoi Agricultural University, Faculty of Economics and Rural Development, Vietnam International Rice Research Institute, Social Sciences Division, Philippines
Project Budget	$732,619
Project Duration	01/07/1999 to 31/03/2004 (Project extended from 01/01/2003 to 31/03/2004)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Economic reforms in Vietnam over the last decade have helped the country attain self-sufficiency in rice and become the world's third largest rice exporter (with productivity increases in rice production of 109% since 1980). Government policy change after 1981 enabled the move away from highly centralised collective farming to the reinstatement of the farm household as the main unit of agricultural production. This project assessed the impact of these changes through economic models, using change in household income levels as the base indicator, and including effects on income distribution, household consumption, employment and market surpluses.

Project outcomes

The project outputs can be cataegorised under three headings: capacity development, a variety of documented policy-oriented models, and research publications with a policy focus.

Four policy analysis training courses involving 135 participants were held. Another two courses, with 52 participants, were funded by an associated AusAID-funded project. The training provided new perspectives on quantitative policy analysis, enhanced computer skills, upgraded analytical capacities, provided new teaching materials and encouraged exchange of ideas between staff of the various institutions. A substantial amount of the training course material on quantitative policy analysis has been translated into Vietnamese, and been widely distributed. Training course material includes a range of documented models suitable for teaching quantitative policy analysis techniques.

The comprehensive household survey of 400 farm households in four provinces, completed over two successive years (2001 and 2002), resulted in a large and rich database of land holdings and land use stataistics, agricultural production at the household and plot level, labour and credit use, and farm and off-farm income.

An interview with 10 senior Vietnamese policymakers was conducted in November 2003. The specific aim of this work was to assess the attitudes of policymakers to current and further land policy changes, and their attitudes to the pace of change and the market for land use rights.

Policy briefs were prepared on the following topics: 'The value of agricultural land and land-use rights in Vietnam', 'Land fragmentation in North Vietnam', 'Interest rate policy changes', and 'Taxes and agricultural land use'. Other publications from the project include 2 refereed journal articles, 2 consultant's reports, 4 project discussion papers (on the topics of Land use flexibility, Land consolidation and accumulation, Tax and credit policies and agricultural land use, and Input and output price policies), 9 conference papers, and numerous workshop and working papers. Further papers are being prepared for journal publication.

AS1/1998/036: Management of rodent pests in rice based farming systems

Overseas Collaborating Countries:	Indonesia, Laos, Malaysia, Vietnam
Commissioned Organisation	CSIRO Sustainable Ecosystems, Australia
Project Leader	Dr Grant Singleton Phone: 02 6242 1658 Email: Grant.Singleton@csiro.au
Collaborating Institutions	Department of Agriculture and Extension, Laos Universiti Putra Malaysia, Malaysia National Institute of Plant Protection, Vietnam Central Research Institute for Food Crops, Indonesia
Project Budget	$1,080,606
Project Duration	01/01/1999 to 30/06/2003 (Project extended from 31/12/2002 to 30/06/2003)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

Losses of the rice crop in Southeast Asia due to rodents can be close to 20% of production, and many farmers feel they have little capacity for rodent control. Earlier ACIAR projects discovered a great deal about rodent feeding and breeding habits and developed an effective control method, based on an early 'trap crop' that captures many animals prior to the ripening of the main crop. In this project scientists undertook further development of an integrated rodent control system, initially at village level then moving to district level. They also investigated prospects for fertility control of rodents through bait delivery of an infertility agent. Project members developed and maintained a 'Rodent Pest Information Network' and contributed to scientist training in Laos, Indonesia and Vietnam.

Project outcomes

In Indonesia and Vietnam, integrated ecologically-based rodent management was applied by farmers at a village level (70-100 ha) at two sites and normal management practices applied at two untreated sites for 2.5 years. The integrated management methods included:

- promotion of synchrony of cropping (crops planted within 2 weeks of each other)
- the use of a community trap-barrier system (cTBS),
- short two-week campaigns to collect rodents at key times (1 week prior to
- transplanting; or within 2 weeks of crop initiation) and in focal (source) habitats,
- where possible to reduce width of irrigation banks to less than 30 cm,
- increase general hygiene around villages and village gardens.

The implementation and testing of integrated rodent pest management was based on a solid understanding of the population ecology of the pest species and of the farming systems, together with strong farmer participation. For example, in Vietnam, radio-tracking and monthly live-trapping indicated that rats used banks of major and smaller irrigation channels during the non-breeding season (tillering stage of rice) and used rice fields during the breeding season (ripening stage of rice). In Indonesia, monthly monitoring of rodent populations across five habitats highlighted that rats aggregated along main channel banks and in village gardens during land preparation. Farmers used this information to develop community-based rat drives along channel banks and around villages during the week prior to transplanting the rice crop or the two weeks after planting.

The integrated approach to rodent management provided strong economic, environmental and policy impacts.

- *Economic impacts*: In Indonesia, there were consistent increases in rice yield (range 0.1 to 0.9 t/ha). In Vietnam, rodent densities were consistently low, however, there was marginally less rodent damage in the treated villages compared to the control villages.
- *Environmental impacts*: There was marked reduction in chemical usage by farmers in the treatment villages. In Indonesia, at the beginning of the study 98% of farmers used chemicals to control rats across all sites. Often these were highly toxic chemicals mixed with oil and then

added to the irrigation water. Two years later chemical usage had dropped to 46% of farmers in the treatment villages (with no oil "cocktails") compared to 88% of farmers in the untreated villages. In Vietnam, all farmers used chemicals across all sites. In the final year of the study, chemical usage had dropped to 4% of farmers in the treatment villages compared to 68% in the untreated villages. There was also a large reduction in farmers using plastic barriers around their crops in the treated villages (70% to 11%), whereas there was little change in the untreated villages (70% to 77%).

- *Policy impacts*: In Indonesia, an integrated "National Rodent Management Program" (Gama Pamati) was developed in 2001 based on recommendations arising from collaborative work funded by ACIAR in West Java. This program now forms the basis for the national policy on rodent pest management in Indonesia.

In Laos, 10 research and extension staff from five provinces were trained at various times in the principles of rodent ecology and management. Projects were established in four upland provinces where data were collected on the history of rodent outbreaks, on breeding and species composition of the rodents, and on the effectiveness of a trap-barrier system (TBS) in the upland habitats. The TBS technology had limited impact in the fields in the upland shifting cultivation systems; however, farmers adapted the technology to protect their valuable grain stores from rats. A volunteer working with the project provided a high quality appraisal of the post-harvest impact of rodents in five upland villages, an assessment of different designs of grain stores and a detailed appraisal of the rodent fauna in forest habitats at one study site.

The first rodent taxonomic key was developed for all the significant rodent pest species and common non-pest rodent species in SE Asian. The key plus species distribution maps, photos of key physical features and a brief description of the biology of each species were published in ACIAR Monograph 100, *Field methods for rodent studies in Asia and the Indo-Pacific* (K P Aplin, P R Brown, J Jacob, C J Krebs & G R Singleton, 2003).

Australian studies of the field ecology of mouse populations have provided a better understanding of the key factors that influence eruptions of mouse plagues. The rate of change of populations during the breeding season is independent of density effects, but if the population density is high at the commencement of breeding then the litter size is depressed throughout that breeding season. There are density-dependent effects on survival during the non-breeding season. Moreover, rates of increase of populations over spring and summer are highly correlated with accumulated rainfall from the previous winter-spring (April-October). These findings have led to:

(a) A refinement of a model for forecasting plagues that has been used successfully in Victoria for the past three years.
(b) Development of a model on fertility control of mice that indicates that sterilising just one third of all female mice for the entire breeding season is sufficient to prevent mouse plagues. This detailed analysis of seasonal population dynamics has established specifications for the use of fertility control of mice that appear quite achievable.

The project had significant capacity-building outcomes, with 18 students undertaking research based on the project as part of their Honours or higher degree studies.

ASEM/1995/119: An evaluation of the sustainability of farming systems in the brackish water region of the Mekong Delta

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Sydney, Australia
Project Leader	Dr Nigel Preston Phone: 07 3826 7221 Email: nigel.preston@csiro.au
Collaborating Institutions	CSIRO Marine Research, Australia Sub Institute of Water Resources, Vietnam University of Western Sydney, Australia University of Can Tho, Vietnam Geological Survey of Vietnam, Vietnam University of Agriculture and Forestry, Vietnam Australian National University, Australia
Project Budget	$997,525
Project Duration	01/07/1997 to 31/12/2002 (Project extended from 01/07/2002 to 31/12/2002)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Integrated rice–shrimp farming systems are rapidly expanding in the brackish water region of the Mekong Delta in Vietnam. Rice has a short growing season, so the use of shrimp as a second crop has increased the farmer's income. However, environmental problems may threaten the sustainability of this system. This project provided a bioeconomic assessment of the sustainability of the current land use practises and investigated government policy options that may promote the sustainability of these farming systems. It also determined sustainable management strategies that could increase productivity and farmer income over the long-term, without creating environmental problems.

Project outcomes

During the project significant progress was made towards understanding the ecological processes, and other factors, underlying the environmental and economic sustainability of rice-shrimp farming systems in the Mekong Delta. Two major factors studied were the effect of salinity on growth and production of a variety of rice, and salinity dynamics in rice fields and their relation to rice production. The results of field trials demonstrated that a new short-duration, relatively salt-tolerant rice variety (MTL119) performed better than the variety that is currently most commonly used by rice–shrimp farmers. There was no conclusive evidence of adverse effects of soil salinisation from shrimp culture on subsequent rice yields.

Sedimentation was another environmental issue examined. Shrimp culture has greatly accelerated the rate of accumulation of sediment because much greater volumes of water (carrying suspended sediments) are now introduced into the rice fields for flushing. The scientists showed that the practice of high water exchange, during the shrimp production cycle, had negative impacts on the rice–shrimp system, and demonstrated that reducing water exchange reduced sedimentation and improved shrimp production. However, closed shrimp production systems with minimal net discharge of wastes into receiving environments, while beneficial from economic and environmental viewpoints, would require an adequate supply of healthy, hatchery reared postlarvae for stocking ponds.

Bio-economic modeling was effective in establishing the complex relationship between the many environmental parameters faced by the shrimp–rice farmers and the considerable income risk they entailed. The model explained income risk in relation to operational factors in a way that could be presented easily to farmers and policymakers. The work demonstrated that rice-shrimp farming has lower financial and environmental risks than shrimp monoculture in the same region.

The project was partially responsible for a new Vietnamese Government decree, which recognised that farmers should be allowed more freedom to implement farming systems rather than being

restricted to systems compatible with national level production targets. The Deputy Prime Minister of Vietnam decided on the basis of the project findings to allow farmers to diversify into shrimp culture in coastal areas and to extend the technology to other provinces.

In advocating rice–shrimp farming as an integrated system, rather than shrimp monoculture, the project has contributed to a more positive attitude towards rice–shrimp against the great tendency to favour shrimp cropping over all other forms of land use. Although the results of this project have clearly demonstrated that rice–shrimp is a lower risk practice than shrimp monoculture, many farmers are seeking to intensify their shrimp production. Project results have informed policymakers about the environmental implications and financial risks of intensification and abandoning the rice crop. Local policy makers are now trying to regulate land practices and thus reduce economic and environmental risks—in some areas in the Mekong Delta land has now been zoned as suitable only for integrated rice–shrimp farms.

The project has greatly assisted the dramatic expansion of rice/shrimp farming taking place in the Mekong Delta. For example, a group of farmers have formed a consortium to carry out shrimp farming using the best practice procedures identified by the project. Project staff from the Mariculture Department at Cantho University, in collaboration with the Danish Government Aid Agency DANIDA, have developed an extension video and CD-ROM that details the best management practices as determined by ACIAR rice-shrimp project. These are now in use throughout the rice–shrimp production region of the Mekong Delta.

To continue the study of shrimp health a fully equipped shrimp viral screening laboratory has been installed at Cantho University and is in constant operation for screening farm stocks and in ongoing shrimp virus research.

CP/1998/018: Bioherbicide development for cereals in integrated weed management

Overseas Collaborating Countries:	Vietnam
Commissioned Organisation	NSW Agriculture, Agricultural Research and Veterinary Centre, Australia
Project Leader	Dr Bruce Auld Phone: 61 2 6391 3826 Email: bruce.auld@agric.nsw.gov.au
Collaborating Institutions	University of Can Tho, Vietnam National Institute of Plant Protection, Vietnam
Project Budget	$462,163
Project Duration	01/07/1999 to 30/06/2004 (Project extended from 01/07/2002 to 30/06/2004)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Selective control of grass weeds, a major problem in cereals such as rice and wheat, is often difficult, and herbicides can contaminate irrigation water used for purposes such as raising fish. Earlier ACIAR-funded research had identified fungi in Australia and Vietnam with potential as bioherbicides for wild oats and *Echinochloa* species, the major weeds of wheat and rice respectively. This project aimed to develop these fungi into bioherbicides for practical use and to establish a blueprint for development of other bioherbicides. The expected outcomes included more integrated weed management and low-tech methods to mass-produce biocontrol fungi with potentially wide application in developing countries and Australia. The project also aimed to produce an illustrated book on the weeds of North Vietnam.

Project outcomes

(Progress to 31/12/2003—final report due September 2004)

In Australia, surveys and pathogenicity testing of fungi for control of wild oats (*Avena fatua*) and annual ryegrass (*Lolium rigidum*) found no sufficiently virulent pathogens for further development. The work on wild oats has been published and the work on ryegrass is being prepared for publication.

In Vietnam, there were two different target weeds in the Red River Delta in the north and the Mekong Delta in the south. In the former, barnyard grass (*Echinochloa crus-galli*) was the target weed and the fungus *Exserohilum monoceras* was selected as a potential bioherbicide. In shade house conditions, with simulated dew, this fungus proved successful but not so in repeated field experiments. It was thought that this may have been due to insufficient water depth at the time of application. An experiment to investigate this was designed but when carried out, the area was flooded and had to be abandoned. This experiment is being repeated. In south Vietnam the fungus *Setosphaeria rostrata* was chosen as a potential bioherbicide for the weed, purple sprangletop, (*Leptochloa chinensis).* This fungus has proven successful under field conditions and compatible with herbicides used to control other weeds. Research on this fungus is now focussed on methods of mass production and application techniques.

FST/1996/005: Development of domestication strategies for commercially important species of Meliaceae

Overseas Collaborating Countries:	Laos, Malaysia, Thailand, Vietnam
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Mr Khongsak Pinyopusarerk Phone: 02 6281 8247 Email: khongsak.pinyopusarerk@csiro.au
Collaborating Institutions	National Agriculture and Forestry Research Institute, Laos Forest Science Institute of Vietnam, Vietnam Forest Research Institute of Malaysia, Malaysia Royal Forest Department, Thailand CSIRO Entomology, Australia CSIRO Plant Industry, Australia
Project Budget	$572,857
Project Duration	01/01/1999 to 31/12/2003 (Project extended from 01/01/2002 to 31/12/2003)
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Major areas of the world's tropical forests are being destroyed and strategies need to be developed to domesticate and improve important indigenous forest trees. This project focused on the indigenous tree, *Chukrasia* in Vietnam, Lao PDR, Malaysia and Thailand, and on the related Red Cedar (*Toona ciliata*) in Australia. It aimed to develop domestication strategies and to identify superior germplasm. Scientists reviewed information on *Chukrasia* and surveyed its distribution. They assembled germplasm in collaborating countries and identified superior provenances for specific sites. The project also developed propagation protocols and methods for studying the floral biology of *Chukrasia* and *Toona*.

Project outcomes

The project addressed two related problems that constrain development in the forestry sector of many tropical countries. These are the need to develop strategies for, and to initiate, the domestication of important indigenous forest trees, and the need to develop the scientific capacity of the national forestry research institutes to perform this work.

Research focused on a commercially important indigenous tree (*Chukrasia* spp.) that is being overexploited in the wild, but not grown commercially in plantations, and on a related species (*Toona ciliata*) in Australia. Both species are in the Meliaceae (mahogany) family and suffer from shoot borers (*Hypsipyla* spp.).

Reviewers found that the project made a good start towards the development of *Chukrasia* as a new forestry/agroforestry species to meet the need for more diversified production systems. The research took place in areas where it can have immediate impact through the dissemination and implementation of the findings.

Project scientists made a major contribution towards the collection of germplasm, seed procurement and the initiation of tree improvement in *Chukrasia*. The study of reproductive biology provided information of importance for a future breeding program. Other information will form the basis of a future domestication strategy.

A great deal of data emerged from the project and these are being analysed substantially beyond the project life. The reviewers identified the need for further analysis that attempts to explain the reasons for the provenance variations in performance.

Reviewers also highlighted the need for information about shoot borer (*Hypsipyla*) damage to *Chukrasia*, since this will be crucial in any decision about a domestication strategy for the species. They recommended closer links with another ACIAR project (FST/1997/024: Insect resistance and

silvicultural control of the shoot-borer, *Hypsipyla robusta*, feeding on species of Meliaceae in the Asia-Pacific region), with the aim of evaluating genetic variability in resistance/tolerance to shoot borer attacks and the selection of individual trees for clonal propagation.

The researchers found greatly superior performance of *Chukrasia* in farmers' fields in Vietnam, compared with forestry sites. This strongly suggests that the species has a good future as an agroforestry species. The usually greater agrodiversity and biodiversity of smallfarmers' fields in the tropics is also likely to be beneficial from the point of view of reducing shoot-borer attacks.

Much of the information gathered in the project has been published in ACIAR monograph 98, *Domestication of Chukrasia* (K Pinyopusarerk & A Kalinganire), 2003.

FST/1997/024: Insect resistance and silvicultural control of the shoot borer, *Hypsipyla robusta*, feeding on species of Meliaceae in Southeast Asia and Australia

Overseas Collaborating Countries	Laos, Malaysia, Philippines, Thailand, Vietnam
Commissioned Organisation	CSIRO Entomology, Australia
Project Leader	Dr Rob Floyd Phone: 02 6246 4089 Email: Rob.Floyd@csiro.au
Collaborating Institutions	National Agriculture and Forestry Research Institute, Laos Forest Research Institute of Malaysia, Malaysia Royal Forest Department, Thailand Department of Environment and Natural Resources, Philippines Queensland Forest Research Institute, Australia Forest Science Institute of Vietnam, Vietnam
Project Budget	$1,093,268
Project Duration	01/01/1999 to 31/12/2003 (Project extended from 01/01/2003 to 31/12/2003)
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Damage from the shoot borer *Hypsipyla robusta* has made it difficult to grow plantations of trees belonging to the family Meliaceae, which include Australian red cedar (*Toona ciliata*), *Chukrasia tabularis*, the mahoganies *Swietenia* spp. and *Khaya* spp., and West Indian cedar (*Cedrela odorata*). All these species produce extremely valuable timber if the young growing tips are not damaged by *Hypsipyla*, because the damage leads to extensive branching, poor form and slow growth. The aim of this project was to find genetic resistance to *Hypsipyla* in *T. ciliata* and *C. tabularis* and understand mechanisms of resistance. The scientists also tested the effectiveness of mixed species plantings and other silvicultural options in reducing *Hypsipyla* damage.

Project outcomes

Hypsipyla robusta is a highly damaging forest pest in terms of both level of attack per individual tree and percentage of trees attacked in each plantation. The project scientists evaluated a wide range of genotypes for genetic resistance to *Hypsipyla*, and investigated whether silvicultural manipulations could ameliorate the problem.

Four *Toona ciliata* and 11 *Cedrela tabularis* genetic resource trials were established and monitored. They found no outstanding seedlots of *Toona ciliata* in terms of resistance to *Hypsipyla* but there is some possibility that individual genotypes may prove to have some resistance. Other trials and experiments focused on issues including pruning, fertilising, insecticides, shade effects, and host selection.

Height: The dominant pattern in all trials was a positive relationship between tree height and *Hypsipyla* damage. If one was to select for fast-growing trees one would unwittingly select for trees that attract more insect damage. The focus for improvement must be on selecting trees that are relatively little damaged in spite of good growth, or that maintain good form in spite of *Hypsipyla* damage.

Species differences: *Khaya senegalensis*, *Cedrela odorata* and *C. tabularis* performed well relative to the average *T. ciliata*. In general these three species grew longer boles and received less *Hypsipyla* damage. *K. senegalensis* was the least frequently damaged species. The relative merit of each species depended on the site.

Pruning: Pruning trials on *C. tabularis* and *T. ciliata* found no advantage in form or growth of trees.

Shade: Growth of *T. ciliata* was examined under an overstorey and in a forest gap. These trees showed performance that exceeded any open-planted *T. ciliata*. Laboratory experiments support this result, indicating *Hypsipyla robusta* prefers to lay eggs on leaves grown at high light. These experiments suggest the most promising approach to *T. ciliata* silviculture is management of a light environment that optimises the balance between tree growth and insect damage.

Plant chemistry: Scientists found that leaf chemistry predicts variation in the *H. robusta* damage of *T. ciliata*. Gas chromatography of *T. ciliata* leaf extracts shows that trees with low damage have more of the compound bicyclo-elemene. They also found differences comparing leaves from high and low light, correlated with the shading effect on oviposition. Together these results indicate that variation in *H. robusta* attack is driven by plant chemistry. Damage reduction requires environments that make the trees constitutively less attractive to *H. robusta*.

Genetic improvement: In the fastest growing *C. tabularis* trial the best seedlot had mean bole lengths approaching 4 m after 36 months. Seedlot 20204 was a consistently good across many sites, ranking among the best with regards bole length, frequency of *Hypsipyla* damage and branching. In contrast, *Hypsipyla* damage was so intense in the *T. ciliata* genetic resource trials that no seedlots and very few individual trees looked 'forestry-ready'. Nevertheless there were significant effects of seedlot on important traits. For example, seedlot 109 was significantly better than most seedlots with regards bole length, frequency of *Hypsipyla* damage, and branching. The presence of seedlot effects on plant traits suggests selection or cloning has the potential to produce better trees.

Also, some seedlots were ranked in the top ten across several of the countries and these, plus a small number of well-performed individual trees could form the basis of further research and demonstration trials. Some seedlots of non-*Toona* species such as *Chukrasia* and *Khaya* in some countries have potential for promotion for future plantings because of their stronger growth, lower attack by *Hypsipyla* and their ability, particularly in the case of *Chukrasia*, to form a vigorous new terminal shoot with a high angle of recovery.

LWR1/1998/034: System-wide water management in publicly managed irrigation schemes in Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Melbourne, Faculty of Engineering, Australia
Project Leader	Associate Professor Hector Malano Phone: 03-8344 6645 Email: h.malano@devtech.unimelb.edu.au
Collaborating Institutions	National Institute for Agricultural Planning and Projection, Vietnam University of Agriculture and Forestry, Vietnam Vietnam Institute for Water Resources Research, Vietnam University of Technology, Ho Chi Minh City, Vietnam Southern Vietnam Institute for Water Resources Research, Vietnam
Project Budget	$788,222
Project Duration	01/01/1999 to 31/12/2003 (Project extended from 01/01/2002 to 31/12/2003)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Vietnam needs substantial efficiency improvements in its irrigation and drainage systems if it is to meet needed future crop yield targets. An earlier ACIAR project (LWR1/1994/004) studied the La Khe irrigation system in the Red River Delta and recommended changes to improve efficiency of operation. This project continued to monitor this early work, and also extended and adapted the findings to the Dan Hoai irrigation scheme in the Red River Delta and the Cu Chi scheme in the Saigon River system. Researchers proposed changes that would encourage farmers to adopt more efficient water use practices. They also developed a system to evaluate resource use efficiency, operational and infrastructure performance, and financial administration that led to better management practices.

Project outcomes

This project focused on the investigation of engineering, agricultural, institutional and economic aspects of improving irrigation management in publicly managed irrigation schemes in Vietnam. It comprised three subprojects which were carried out at three irrigation schemes: two pump-operated schemes located in Ha Tay Province: Dan Hoai and La Khe; and the other, the Cu Chi scheme a gravity-fed scheme located in Southern Vietnam. The project aimed to improve the standard of operation and management of the three irrigation systems by improving their technical capacity to manage water distribution and by introducing new institutional arrangements. It built upon the improvements of the technical capacity of the Le Khe irrigation company and associated new institutional arrangement tested in an earlier project (LWR1/1994/004). The project also developed a system of performance evaluations in terms of resource use, operation, infrastructure use, and finances. Performance evaluation aimed to allow measurement of changes in response to the improved water distribution and institutional arrangements introduced by the project. New areas of research in the project included means of improving infrastructure survey methods and new methods for crop identification and area estimation. The latter were derived from data collected in Australia and the Philippines using airborne synthetic aparture radar.

The project completed the development and application of the Irrigation Main System Operation model (IMSOP) in all three irrigation systems (available in English and Vietnamese). The process involved implementation of the IMSOP model to simulate the operation, retrospective analysis of the system, monitoring existing operation and field trial of alternate operational scenarios.

Project scientists designed and developed a GIS based Asset Management Framework and Software which can be used to manage infrastructure in any irrigation scheme. The software tool can be used to maintain an up-to-date database of asset condition and carry out various financial calculations and modelling including depreciation and condition based renewal costs.

A seven-step development process leading to the formation of a Water User Association under the Cooperative Law in secondary canal N5 in the La Khe irrigation system was completed and trialled for 2 years. The Water Users Association model had provided benefits to farmers although it is still largely viewed by local authorities as an advisory body. A WUA charter, internal regulations and constitution were developed. Whilst the model was shown to function well as a locally managed irrigation and drainage organisation, the future extension of this model to other systems is closely linked to the ability of the Vietnamese authorities to speed up reforms in the irrigation sector.

The main effort in Subproject II was directed to the evaluation of water productivity in Cu Chi and economic analysis to evaluate the water management changes. Water balance measurements were carried out in the experimental area for the main crops in 2001 and 2002 and Winter–Spring crop in 2002. The analysis of water balance showed very low water productivity of rice in Cu Chi in both the years (0.6 kg/m^3). During the Winter–Spring season farmers cultivated peanuts and corn in addition to rice. Farmers' income from rice was estimated at A$400 per ha, whereas combined crop of rice, corn and peanut would give a higher income (A$860 to A$970).

The economic component of the study focused on the assessment of farmers' profitability, the impact of available water supply on rice yields, returns from agriculture and household income. The study of gross margin in the three systems concluded that a wide diversity exists between systems and within them. Variability in the availability of water within the system appears to have little effect on the yields and incomes of farmers in La Khe. In Dan Hoai there is some evidence that Winter–Spring rice yields are lower for farms located at the end of the irrigation system. In Cu Chi, yields for all rice crops were lower for farms at the end of the system, and net returns per hectare from cropping activities highest at the top of the system. It should be remembered however that many factors other than water availability affect crop yields and this study does not account for other possible factors influencing yield variability.

The process of implementing volumetric prices in Vietnam is difficult, due to institutional immaturity, and the nature of the irrigation infrastructure in Vietnam. The project proposed that water should be charged according to a two-tier formula based on the water user associations buying water on a volumetric basis from the irrigation management company and charging farmers on an area basis. Such an approach will provide incentives for water users associations to buy as little water as possible and for farmers to ensure that the water is distributed as equitably as possible within the WUA.

PHT/1993/877: Low cost disinfestation systems for fruit

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	Queensland Department of Primary Industries, Horticulture Postharvest Group, Australia
Project Leader	Mr Rod Jordan Phone: 07 54662259 Email: rod.jordan@dpi.qld.gov.au
Collaborating Institutions	Ministry of Agriculture and Rural Development, Vietnam Research Institute of Fruit and Vegetables, Vietnam Department of Agriculture, Thailand
Project Budget	$871,137
Project Duration	01/01/1998 to 31/12/2003 (Project extended from 01/07/2001 to 31/12/2003)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

International trade of fruit and vegetables in the Asia Pacific region including Australia is severely constrained by quarantine barriers against fruit flies. Trade barriers also exist within Australia. The removal of barriers requires a postharvest disinfestation treatment. Heat and cold treatments, which produce no residues, are now favoured over chemical applications. However, heat and cold treatments frequently affect fruit quality and disease development and control, and are technically complicated to apply. This project investigated alternative, low-cost heat systems with the aim of reducing the complexity of the technology. This is expected to lead to major reductions in cost, making the treatment available for use at the farm level.

Project outcomes

The project has been primarily focussed on the development of methods of heat treating fruit for quarantine disinfestation against fruit flies which could be achieved using low-cost treatment equipment developed by the Queensland Horticulture Institute. In Australia, the development and commercialisation of this equipment has progressed to the point where a commercial unit of five tonne capacity has been produced at a substantially lower cost than any other commercial equipment available.

The first objective was to establish appropriate facilities for disinfestation research in Vietnam (including fruit fly culture and postharvest physiology studies). Laboratories at Vietnam's Plant Protection Department (PPD) and the Research Institute for Fruit and Vegetables (RIFAV) were refurbished, colonies of two fruit fly species were established and the methodology for in vitro thermotolerance studies standardised. Vietnamese staff were trained in fruit fly culturing techniques, management of the fly colony, and development of disinfestation treatments, in collaboration with the Department of Agriculture (DoA) quarantine research group in Thailand. A low cost artificial medium was developed as a fruit fly diet. RIFAV staff were provided with intensive training in use of the equipment provided and in postharvest experimental methods, covering such areas as experimental designs, quality and sensory evaluation methods and statistical analysis. The research leader received additional specialist training and management training in Australia as a recipient of an ACIAR-funded John Dillon Fellowship.

The second objective was development of heat treatment conditions. In Thailand the mangosteen, pomelo and longan have been investigated. The Department of Agriculture in Thailand has now satisfied all technical requirements to obtain entry of mangosteen to Japan, and commercial shipments were able to commence. The project has demonstrated that slower heating rates reduced the incidence of fruit injuries, while there was no difference in injury incidence between air and water cooling. Air cooling is preferred however, because its slower cooling rate will not impact on treatment efficacy. In 2002, the disinfestation systems were further developed to minimise fruit injury and disease development in litchi, oranges and mangoes. A commercial collaborator is assisting with installation of a demonstration pilot-scale heat treatment unit.

RIFAV undertook storage studies of lychee, demonstrating that shelf life can be prolonged up to 35 days with an acceptable loss of quality. Preliminary experiments on the effects of heat on dragon fruit quality have shown that hot water dipping (52°C for 10 minutes) results in no loss of quality. This work is continuing.

Achieving treatment efficacy at the levels for many importing countries can be difficult without causing product injury. Some of the Australian research looked at technical options for reducing damage risk while maintaining treatment efficacy. It was hypothesised that slow air heating using low temperatures and relative humidities in the early stages of treatment, can reduce the incidence of fruit injuries. This approach was assessed on mangosteen, tomato, mango and papaya. Pre-treatment conditioning at 38°C for 12-18 hours was found to be very effective in reducing injury development induced at higher temperatures but the treatment efficacy also fell under these conditions. An alternative approach to increasing treatment efficacy consisting of a pre-treatment using atmosphere modifications was investigated.

High levels of insect mortality occur when a low oxygen pre-treatment stage was incorporated in the total treatment process using milder temperatures. Elevated carbon dioxide appeared to have little effect. In the early stages of the work, pre-treatments were carried out in converted incubators and product was manually transferred to the heat treatment chamber. This led to inconsistent and difficult to interpret results. Improvement of treatment systems was completed within a complementary project (funded by Australian agencies) by fabricating a dedicated low oxygen treatment chamber. Effective treatment conditions, which do not injure the fruit, have been developed for disinfestation of 'Kensington' mango for *Bactrocera jarvisii.* Similar work for papaya is well advanced.

A third objective involved development and evaluation of low-cost treatment systems. An experimental version of the new treatment system developed in Australia was supplied to the PPD in Hanoi. This unit was designed to treat up to ten crates each containing up to 10 kg of product. The unit can be operated fully automatically if required. The was used to investigate heat tolerance of immature stages of two fruit fly species, *Bactrocera dorsalis* and *Bactrosera cucurbitae*, leading to determination of the most tolerant stage of *B. dorsalis* in dragon fruit. In Vietnam the ACIAR project is linked with an AusAID-funded CARD project, which has enabled additional capacity-building through the involvement of engineers at the University of Agriculture and Forestry in Ho Chi Minh City in the construction of a second prototype treatment unit at PPD in Ho Chi Minh City, using locally available materials.

Towards the end of the project, when a suitable site became available at RIFAV, a small pilot commercial unit was installed. While the capacity of the unit was only slightly higher than the experimental units built previously, the design was such that it provided a concept for scaling up to small commercial scale. In Australia the project also provided some technical support to commercial scale-up of the treatment technology.

The use of disinfestation heat treatment is a preferred disinfestation technology in the Asian and Pacific region. Many countries maintain an active interest in the system. They may be currently developing and using the process for export, or needing to evaluate data generated in the systems in submissions for import approval. Other countries are working towards being able to utilise the process. For these reasons, harmonisation of treatment development and broad agreement on experimental data development methods and interpretation is of significant importance to trade in the region. The project contributed to draft 'Guidelines for the development of quarantine disinfestation heat treatments for fresh horticultural produce for fruit flies' developed through an APEC workshop and a follow-up meeting.

PHT/1995/134: Management of *Phytophthora* diseases of durian

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	University of Melbourne, School of Botany, Australia
Project Leader	Professor David Guest Phone: 02-93512946 Email: guestd@agric.usyd.edu.au
Project Web Site	http://www.botany.unimelb.edu.au/botanyunimelb/1pages/research/labs/mycology/duriansite/index.html
Collaborating Institutions	Department of Business, Industry and Resource Development, Northern Territory, Australia Southern Fruit Research Institute, Vietnam Kasetsart University, Thailand Queensland Department of Primary Industries, Australia
Project Budget	$649,280
Project Duration	01/07/1998 to 31/12/2003 (Project extended from 01/01/2002 to 31/12/2003)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

The popular tropical fruit durian is prone to fungal diseases, notably fruit rot, root rot, patch canker and dieback, largely due to the *Phytophthora* fungus. Market losses from these conditions are in the order of 15–30%, and the impact is felt elsewhere in the loss of trees and in postharvest rots that can destroy whole consignments in storage and transit. This project developed an integrated disease management strategy, based on information gathered on the host range, geographical distribution and virulence of *Phytophthora* strains isolated from different durian-growing areas. The scientists also tested how injecting phosphonates directly into the tree can control the fungus. Phosphonates have a low toxicity for mammals and have been found highly effective in controlling *Phytophthora* diseases in cocoa and avocado.

Project outcomes

In line with the primary aim of the project, the key output was a set of recommendations for the integrated control of *Phytophthora* diseases in durian in each location for disease control, from the nursery through to postharvest handling:

Disease control in nurseries: Pathogen-free potting media is fundamental to producing healthy plants, yet the cost of soil pasteurisation equipment is currently beyond the finances of most private nurseries in Vietnam. The project team recommended a search for alternatives to coconut fibre and rice husk, because the research showed that potting media used in Vietnam harbour *Phytophthora*. Researchers developed bioassays to screen durian germplasm for disease resistance, and put forward local recommendations for propagation of disease-tolerant varieties.

Disease control in orchards: Integrated disease management (IDM) in orchards is achieved through planting disease-tolerant material (wherever possible), by implementing appropriate orchard management practices, cultural and biological controls and through the judicious use of appropriate chemicals. The project demonstrated the efficacy of composted animal manures in improving tree health and reducing disease incidence, and recommended time and rate of application. Other outcomes included identifying suitable cover crops for durian in Australia's Northern Territory (NT), and identifying local sources of suitable mulch and care in its removal in the wet season. The scientists demonstrated the role of fallen fruit, at all stages of development, as sources of inoculum that harbour *Phytophthora* and other pathogens. They developed recommendations for the rate and timing of phosphonate trunk injections, which have proven spectacularly successful in ameliorating patch canker in Vietnam.

Postharvest disease control: Controlling *P. palmivora* in the orchard improves the quality of the harvested fruit. Specific fruit treatments were formulated to further reduce the incidence of fruit rot. Manual harvesting, as conducted in Thailand, was recommended for all regions. However, as

harvesting indices were not available for the highly variable Vietnamese cultivars, the scientists recommended that fruit be tied to branches to allow natural abscission without the associated disease and injury problems of allowing the fruit to drop to the ground.

Technology transfer: A top priority of this project was the dissemination of recommendations to the durian industry. This process has been greatly assisted by the fact that the collaborating institutions are either extension agencies or have a strong extension culture. Research findings and recommendations have been communicated through training courses, on-farm demonstrations, the use of electronic and written (newspapers, magazines, pamphlets) media, project website and growers groups. The durian project website (www.botany.unimelb.edu.au/botanyunimelb/1pages/research/labs/mycology/duriansite/index.html) has attracted widespread interest and comment from farmers and scientists in several countries not involved in this project.

Capacity building: This project has made a significant contribution to horticultural research capacity of the partner countries, especially Vietnam. The skills and research capacity of collaborating institutions have been significantly enhanced through this project, which has not only had direct positive impact on the results achieved, but will provide a lasting legacy for institutions and scientists.

PHT/1996/004: Monitoring mycotoxins and pesticides in grain and food production systems for risk management in Vietnam and Australia

Overseas Collaborating Countries:	Vietnam
Commissioned Organisation	University of Sydney, Faculty of Agriculture, Australia
Project Leader	Professor Ivan Kennedy Phone: 02 93513546 Email: i.kennedy@acss.usyd.edu.au
Collaborating Institutions	University of Agriculture and Forestry, Vietnam Postharvest Technology Institute, Vietnam Pasteur Institute, Vietnam CSIRO Plant Industry, Australia Australian Wheat Board, Australia
Project Budget	$839,749
Project Duration	01/07/1999 to 30/06/2004 (Project extended from 01/07/2002 to 30/06/2004)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Contamination of food and feedstuffs with mycotoxins or pesticides is a hazard to the health of people and livestock in Vietnam and Australia. Contaminant testing is becoming an essential part of market access compliance and increasingly, a serious barrier to equitable market access by developing countries. This project was established in Vietnam to enhance the monitoring of contamination of agri-produce by mycotoxins and pesticides. The project's objectives included development of sampling protocols and field-laboratory immunoassays for a range of mycotoxins and commonly encountered pesticides, and training of Vietnamese researchers from provincial laboratories in their use. Following an initial survey to establish the incidence and severity of contamination of a range of commodities in both countries, the collaborators intended to establish a network for the ongoing monitoring of mycotoxin and pesticide contamination in agricultural produce (food and feed) and fermented foods, based around Vietnam's existing provincial laboratories.

Mycotoxins and pesticides are two groups of contaminants of agri-produce that present similar analytical challenges. Methods of analysis for mycotoxins and pesticides divide into two groups, those based on expensive instrumental techniques and the cheaper tests based on the specificity of biological recognition systems. Two examples of the latter type of technology are the enzyme-linked immunosorbent assay (ELISA) and immuno-affinity chromatography (IAC). Vietnamese partners in this project had already acquired some expertise in both methods. By further developing this expertise the project aimed to make access to the technology affordable for Vietnam, while enhancing the country’s capability for 'international validation' of its testing/certifying capability. Research work in this project has also been closely coordinated with three other related projects in Vietnam and Indonesia funded by ACIAR, AusAID and the British agency DFID.

Project outcomes

Progress to June 2003—final report due in September 2004

The project's achievements include: identifying pesticide and mycotoxin targets for immunoassays based on surveys of Vietnamese agricultural produce, knowledge of pesticide usage, and climatic conditions; training Vietnamese scientists to postgraduate level in immunochemical techniques, particularly in the chemical procedures required; development of immunoassays for aflatoxin B1, ochratoxin A, alternariol monomethyl ether, DDT and endosulphan; and the training of scientists in high performance liquid chromatography (HPLC) techniques to support assay validation.

Prototype kits were developed in both ELISA and immunoaffinity column forms for aflatoxin B1. The kits are being used in Vietnam (at feedmills) and independent validation of the prototype kits is taking place. The project is continuing to train Vietnamese project scientists in the specialist methodology for the development of immunoassays and related technology, such as immunoaffinity chromatography,

and in protocols designed for their application, enabling the technology development to continue after the ACIAR project is completed.

Surveys of mycotoxin and pesticide contamination in Vietnam are continuing. Using the immunoassays technology developed during the project, aflatoxin contamination in mixed feed has been found at feeds mills in Ho Chi Minh City (HCMC). Contamination with aflatoxin B1 and B2 (but not G1 or G2) correlated well with the survey of fungi producing aflatoxins in which *Aspergillus flavus* but not *Aspergillus parasiticus* was able to be isolated from the feedstuffs. Surveys of pesticide contaminants identified esfenvalerate as a priority ecotoxin for future ELISA development.

Project partners have transferred the technologies to groups at Hanoi University of Science and the Center for Analytical Scientific Experimentation, HCMC for surveys of produce and environmental soil and water samples, and worked closely with the Plant Protection Department in HCMC. These linkages have strengthened the quality control monitoring network in Vietnam.

The Postharvest Technology Institute (PHTI) is continuing development of ELISA kits and immunoaffinity columns. The Institute is producing and transferring ELISA technology to Vietnamese partner institutions, and providing the technical expert backup and opinion needed for application in the field. The PHTI also conducted experiments on overcoming matrix effects in market produce, assisted by an AusAID Youth Ambassador who had previously worked on endosulfan analysis using immunodiagnostics at the University of Sydney.

The aflatoxin and cyclodiene kits have now been developed to a level of sensitivity where they can be used for routine application. Collaborative work in Australia with Queensland Department of Primary Industries and Fisheries and the Peanut Company of Australia validated the aflatoxin B1 ELISA kits (SunQuik aflatoxin B1 test and PHTI's aflatoxin test), showing very good agreement with data obtained by HPLC and commercial technology with immunoaffinity columns. New technology for ELISAs and IACs for ochratoxin A was also developed in both countries. In Australia, these tests will be relevant to contamination in products such as grape and wine, whereas in Vietnam, ochratoxin in coffee has been shown by the PHTI to be a problem for overseas trade.

PHT/1996/193: Survey of the presence and importance of Phytophthora in Southeast Asia

Overseas Collaborating Countries:	Indonesia, Malaysia, Philippines, Thailand, Vietnam
Commissioned Organisation	Cooperative Research Centre for Tropical Plant Protection, Australia
Project Leader	Dr Andre Drenth Phone: 0738969345 Email: Andre.Drenth@dpi.qld.gov.au
Collaborating Institutions	Southern Fruit Research Institute, Vietnam Kasetsart University, Thailand Prince of Songkla University, Thailand Bureau of Plant Industry, Philippines Research Institute for Spice and Medicinal Crops, Indonesia Malaysian Agricultural Research and Development Institute, Malaysia
Project Budget	$149,943
Project Duration	01/07/2000 to 30/06/2003 (Project extended from 01/07/2002 to 30/06/2003)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

The fungus, *Phytophthora* is one of the most important plant pathogens worldwide, causing large losses in agriculture. Many important crops in Southeast Asia and Australia are susceptible, including citrus, rubber and cocoa. At the regional and individual level, farmers have little information available about *Phytophthora.* The project aimed to consolidate information already known about the fungus. The scientists conducted a disease survey in Southeast Asia about practical *Phytophthora* problems in agriculture and forestry. They also identified local expertise and assessed the facilities available in the collaborating countries. This information has provided a basis for workshops on *Phytophthora* and for designing subsequent research projects.

Project outcomes

One of the main outcomes from the *Phytophthora* survey is a detailed overview of different *Phytophthora* diseases that have been identified in the collaborating countries in Southeast Asia. In a range of important major crops such as cocoa, pepper, durian, rubber, coconut, citrus, potato, tomato, and papaya significant losses occur on an annual basis with disease epidemics under favourable weather conditions. By far the most common and important *Phytophthora* species is *P. palmivora* that occurs on a range of different host plants. *P. nicotianae* is also important on a range of crops including citrus, while *P. capsici* is causing considerable losses in the production of pepper. *P. infestans* is important in the highlands, where it causes significant losses to potato and tomato production.

Another major outcome of the survey is a significant increase in the ability of many researchers in the region to recognise disease symptoms caused by *Phytophthora* at an early stage. To aid the transfer of knowledge in this area a small handbook, 'Practical guide to detection and identification of *Phytophthora*', was written and widely distributed.

The project involved hands-on training in the field to detect, identify and manage plant diseases caused by *Phytophthora* in various locations in all five countries involved. This training in early disease detection allows targeted control of *Phytophthora* diseases in the field. In addition to the Practical Guide all participants were also provided with a comprehensive reference book on the genera *Phytophthora*. The impact of this increased capability to recognise and deal with *Phytophthora* diseases should form the foundation for improved detection, identification and control of *Phytophthora* diseases in the years ahead.

An important output of this project is input in other ACIAR projects (PHT/1995/134 Management of *Phytophthora* diseases of durian; PHT/2000/102 Selection for improved quality and resistance to

Phytophthora pod rot, cocoa pod borer and vascular streak dieback in Indonesia; and CS2/1994/965 Diagnosis and control of plant disease in northern Vietnam.) At the end of this project a workshop was held in collaboration with the durian project (PHT/1995/134) in Chiangmai in October 2002. During this workshop information regarding the occurrence, aetiology, and management of *Phytophthora* was reviewed and recommendations for integrated management of *Phytophthora* diseases discussed. In addition it brought together scientists from the collaborating countries to share information and form professional linkages throughout the region.

Detailed information concerning the occurrence, distribution, impact and management of different *Phytophthora* diseases in Southeast Asia is being collated in a monograph on *Phytophthora* in Southeast Asia which is being published by ACIAR.

CS2/1998/078: Sustainable integrated management of whiteflies as pests and vectors of plant viruses in Asia

Overseas Collaborating Countries:	Bangladesh, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam
Commissioned Organisation:	International Centre for Tropical Agriculture, Colombia
Project Leader	Dr Francisco Morales Phone: 57 2 4450-000 x3379 Email: f.morales@cgiar.org
Collaborating Institutions:	Department of Agriculture, Thailand Regional Agricultural Research and Development Centre, Sri Lanka CSIRO Plant Industry, Australia Bogor Agricultural University, Indonesia Institute of Agricultural Sciences of South Vietnam, Vietnam CSIRO Entomology, Australia Asian Vegetable Research and Development Centre, Taiwan University of the Philippines at Los Banos, Philippines Malaysian Agricultural Research and Development Institute, Malaysia Bangladesh Agricultural Research Institute, Bangladesh Nepal Agricultural Research Council, Nepal Research Institute of Fruit and Vegetables, Vietnam Cantho University, Vietnam
Project Budget:	$562,000
Project Duration:	01/01/1999 to 31/12/2003 (Project extended from 01/01/2002 to 31/12/2003)
ACIAR Research Program Manager:	Dr Paul Ferrar

Project background and objectives

Whitefly (*Bemisia tabaci*) is one of the most intractable and devastating pests of vegetable and cotton industries throughout the world. Not only is its effects felt from the damage caused by feeding, but in many cases it is also responsible for the transmission of plant viruses that, when they occur together, often result in total crops losses. This project was part of the Tropical Whitefly IPM Project, coordinated by CIAT. It involved collaboration between CSIRO Entomology and CSIRO Plant Industry in Australia, AVRDC in Taiwan and collaborators in Sri Lanka, Bangladesh, Malaysia, Indonesia, Philippines, Thailand, Nepal and Vietnam. It aimed to improve understanding of whitefly in the Asian region, determining its extent and studying the dynamics of the virus diseases it carries. A number of surveys and collection missions in the collaborating countries were undertaken to identify different whitefly biotypes, host plants, natural enemies and associated plant viruses.

In Vietnam, the overall goal of the project was to identify components for inclusion in a sustainable integrated pest management (IPM) strategy for control of whitefly-transmitted geminiviruses (WTG) and whiteflies on tomato. Two Vietnamese institutions agreed to join the project in June 2002 so that experiments could be conducted in northern and southern Vietnam under diverse environments.

Project outcomes

Two genetically distinct tomato-infecting geminiviruses from north and southern Vietnam were isolated, cloned, and sequenced. The virus from north Vietnam is most similar to a geminivirus from Taiwan (88% homology) while the virus from southern Vietnam is a strain of a geminivirus from Thailand. The chances are high that AVRDC-resistant lines will hold up against the virus from northern Vietnam or similar viruses. Reaction of AVRDC resistance to the virus from the south is unknown and needs to be determined. The wide range of genetic diversity among the geminiviruses

from Vietnam and other parts of SE Asia emphasises the importance of developing resistant lines carrying multiple resistance genes in order to have effective and durable resistance in the region.

After two years of on-station and on-farm testing in north Vietnam, two fresh market tomato hybrids, FMTT847 and TLCV15, were identified as highly promising for farmer adoption. Under moderate or high geminivirus pressure in farmers' fields, these two hybrids yielded 30-400% more than local geminivirus-susceptible cultivars. Parental lines of the hybrids have been provided to the Research Institute of Fruit and Vegetables, Vietnam (RIFAV) to enable seed production of the hybrid for farmers. AVRDC will make these two hybrids available to researchers in other countries for evaluation and possible release. However, both hybrids were susceptible to geminivirus when tested in an on-station trial at Cantho University in southern Vietnam.

The efficacy of petroleum spray oil (PSO) versus conventional pesticide and control (water) treatments in reducing/repelling whitefly populations and reducing geminivirus infection was evaluated in three on-station experiments at RIFAV in north Vietnam. Adult whiteflies but not nymphs were present on tomato plants, suggesting that local whitefly populations cannot complete their lifecycle on tomato. The *Bemisia tabaci* genetic group in north Vietnam may be Nauru instead of Asia 1 as previously thought. Weekly applications of PSO at rates of 1% or 2% reduced geminivirus incidence to 8-18% compared to 25% for the water control. For both non-resistant and resistant varieties, PSO application rates of 1% or 2% also increased marketable fruit yields by 50-92% compared to the water control. PSO technology combined with resistant varieties showed excellent potential as a component in an overall geminivirus IPM strategy and a safe substitute for insecticides. Furthermore, the large yield increases provide strong evidence that the PSO applications provide additional benefits to tomato crops beyond geminivirus control.

CP/1999/007: Developing disease management capacity in Vietnam

Overseas Collaborating Countries:	Vietnam
Commissioned Organisation	Centre for Agriculture and Biosciences International, Plant Pathology, UK
Project Leader	Dr Mark Holderness Phone: 44 0 1491 829043 Email: m.holderness@cabi.org
Collaborating Institutions	Hanoi Agricultural University, Vietnam Institute of Agricultural Sciences of South Vietnam, Vietnam Hue University of Agriculture and Forestry, Vietnam National Institute of Plant Protection, Vietnam Postharvest Technology Institute, Vietnam Southern Fruit Research Institute, Vietnam University of Can Tho, Vietnam Ministry of Agriculture and Rural Development, Vietnam Queensland Department of Primary Industries and Fisheries, Australia
Project Budget	$773,916
Project Duration	01/01/2001 to 30/06/2004 (Project extended from 01/01/2004 to 30/06/2004)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Until now, Vietnam has lacked the necessary skills base to overcome problems of diseases in perennial fruit crops and some industrial crops and vegetables. This project aimed to increase the plant pathology research skills and plant disease management skills of Vietnamese scientists through provision of training programs in a variety of relevant skills; improved access to information; advice on development of research programs; and operation of practical research programs in a number of crops and commodities of increasing importance to Vietnam. Crops included perennial fruits planted to rehabilitate degraded lands (and provide incomes for poor farmers in mountain regions) and industrial crops such as sugar, coffee, tea and cocoa. Vegetables will also be included in some areas to assist Vietnam's national vegetable integrated pest management program. Involvement of researchers with farmers and extension workers in all of the practical projects was a strong feature of the project design. The building of linkages between the various institutions working on these problems throughout Vietnam was also emphasised, to facilitate better collaboration through improved efficiency and synergy.

Project outcomes

The topics addressed by the project team in tackling the development of capacity in disease management and plant health were wide ranging. They included new methods for linking research to extension, and combined improving skills in the laboratory with major improvements in field science and diagnostics.

The project trained more than 250 young scientists and extension workers in 17 courses and workshops. Plant health diagnosis in both field and laboratory was a major focus, and has resulted in observable improvements in how diseases are recorded and information is passed both from field to institutes (a vital link in delivering improved quarantine intelligence) and from laboratory to field (an equally vital link for more effective management of diseases).

Customised training materials were developed to support the training efforts. These included a manual on 'Laboratory techniques for plant health diagnostics' (mostly laboratory based) and the first trainers' manual on 'Plant health diagnostics in the field'. This manual instructs and guides local trainers on how to deliver the course within Vietnam under a proposed national program aimed at increasing the capacity of extension workers, The focus on symptom-based diagnostics was crucial in changing the mindset of scientists and extension officers towards disease management in the field.

One of the partners (SOFRI) has begun a new initiative to prepare 12 Vietnamese trainingn modules with handouts, flip charts and Powerpoint presentations based on the project activities, which will be used to train the next generation of extension officers. The project laid the ground for an integrated approach to plant health management, but institutional changes need to be maintained and progress consolidated.

The project has resulted in a range of methods and tools for doing research on diseases that include the biology and ecology of pathogens, farmer participatory research on IPM, linking research to extension, and analysing local knowledge of diseases. These methods and tools have been tested and validated for Vietnam, providing a model for other countries seeking to build capacity.

When doing surveys of the disease status of horticultural crops, it is critical to first ensure that the real issues are being addressed and appropriate training in field diagnostics is provided before embarking on the survey work.

The project produced a comprehensive compilation of survey data. As part of the project, staff of the Queensland Department of Primary Industries and Fisheries collated and summarised pathogens and diseases identified by related ACIAR projects in Vietnam, a valuable step in making project outputs more widely available.

The project helped broaden young scientists' understanding by demonstrating what can be learned from how farmers approach disease management, and the benefits of collaborative research with farmers. The Going Public method (a simple yet effective method for interacting with farmers that is quick and cheap) was introduced and tested in public places such as markets, to show, gather and share information with farmers.

Participatory research was undertaken on newly emerging problems in Vietnam that are having a devastating impact on farmers' incomes (pineapple mealybug wilt and dragon fruit branch rot), and on established, well-know pathogens that lacked appropriate management options (eg litchi and chilli anthracnose, tomato bacterial wilt, citrus huanglongbing). Treatments varied from use of organic fertiliser to sanitary pruning, vector control and use of fungicides. The control strategies developed were informed by farmer knowledge and practical constraints in the field.

Project work done by the various institutes on key diseases of priority crops has been made available in separate technical reports.

Projects under development
as at 30 June 2004

Bilateral

ADP/2002/015: Managing groundwater access in Tay Nguyen (Central Highlands) Vietnam

ADP/2002/092: Free trade agreements in East Asia—their effects on agricultural trade

ADP/2002/105: Economic and market analysis of the live reef fish food trade in Asia-Pacific

AS2/2002/078: Improved beef production in central Vietnam

ASEM/2002/103: Enhancing project impact and science capability through ongoing evaluation

CP/2002/115: Development of provincial and district level diagnosis and control of crop fungal diseases in Vietnam

FIS/2000/065: Assessing the potential for low cost formulated diets for mud crab aquaculture in Australia, Indonesia and Vietnam

FIS/2001/058: Sustainable tropical spiny lobster aquaculture in Vietnam and Australia

FIS/2002/077: Improved hatchery and growout technology for marine finfish aquaculture in the Asia-Pacific region

FST/1999/095: Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and silviculture

FST/2001/021: Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: sawing and drying

FST/2002/098: Land capability assessment for forestry and agroforestry in southern Vietnam and Queensland

FST/2002/112: Domestication of Meliaceae species in Southeast Asia and Australia, particularly management of the problem of *Hypsipyla robusta* attack

LWR/2002/085: Utilising basic soil data for the sustainable management of upland soils in Vietnam and Australia

PHT/2002/086: Improving postharvest quality of temperate fruits in Vietnam and Australia

SMCN/2002/073: Efficient nutrient use in rice production in Vietnam achieved using inoculant biofertilisers

Vietnam consultations

12–13 February 2004

Indicative priorities for ACIAR projects in Vietnam

Priorities for collaborative agricultural research between ACIAR and Vietnam were discussed on 12–13 February 2004 at a consultation with representatives of relevant Vietnamese Government Ministries, departments and research organisations. These priorities are not to be considered as officially sanctioned priorities of the Government of Vietnam. They are priorities expressed by participants at a consultation at a particular point in time. ACIAR will use them as a framework when assessing proposals for collaborative projects to be supported by ACIAR, subject to further advice and information from Vietnam.

The ACIAR portfolio emphasises selected areas within the disciplines of agricultural development policy, crop protection and postharvest technologies, fisheries, forestry and aspects of animal production and land and water resources management. Researchers intending to seek ACIAR support for collaborative research projects with Vietnamese counterparts should, in the first instance, approach the relevant ACIAR Research Program Manager.

Overarching emphases include research to assist enhancement of smallholder incomes through crop and livestock diversification within farming systems, and improving market access through the improvement of the safety and quality of agricultural products. Research will examine the comparative advantage of particular commodities for domestic and export markets and options for the development of rural agricultural enterprises, including efficiencies of cooperative production and marketing. Fisheries research cooperation will focus on aquaculture, while forestry cooperation will address both conservation and utilisation, with an increased emphasis on higher-value products. Natural resource management research will emphasise sustainable cultivation systems for poor sandy soils in central Vietnam and acid sulfate soils in the Mekong Delta.

While much of ACIAR's program will remain based in greater Ho Chi Minh City and Hanoi because of the location of research institutes, the national relevance of the outputs of much of the research and the need to deliver the results of policy research to government stakeholders, there will be an increased emphasis on central Vietnam, particularly central coastal provinces. There will also be an increased emphasis on implementation of the results of earlier ACIAR-funded research including developing manuals and other communication materials.

The majority of ACIAR-supported informal and postgraduate research degree training will continue to be delivered within the context of active projects. However, ACIAR will also support short-course training in selected areas, including: experimental design and statistical analysis; research management; research monitoring and evaluation; scientific proposal/grant writing and project design; biotechnology (particularly use of molecular markers); writing for scientific, extension, farmer and government audiences; and collection and analysis of market information. Specific project priorities are listed under ACIAR program areas:

Agricultural Economics and Development Policy

- Policy options for optimising future market-oriented crop (particularly rice) production in Vietnam, including understanding of the role of stakeholders in policy, production and markets
- Options for development of small-scale agro-enterprises in rural areas, including institutional and market chain analysis
- Assessment of and industry planning for possible impacts of trade agreements, particularly on the fisheries sector
- Policy options for cooperatives in agricultural (particularly fisheries) production and marketing systems to deliver improved and more secure returns to smallholders

Animal Sciences

- Smallholder pig production systems including nutrition, housing, health and meeting market requirements
- Smallholder production of beef and small ruminants within crop–livestock systems including nutrition, genotype assessment and management
- Incentives and regulatory issues for improved animal waste management in peri-urban areas

Fisheries

- Cost-effective and environmentally-friendly aquaculture feeds, with greater use of locally available nutrient sources
- Profitable environmentally responsible grow-out technologies for marine cage culture, and pond culture in sandy coastal areas
- Transferring existing knowledge from ACIAR fisheries projects in other countries, with particular attention to shrimp health

Crop Protection and Postharvest Technology

- Enhancement of disease and pest diagnosis and management for perennial crops of Central Vietnam
- Integration of practical fruit fly strategies with the management of other insect pests
- Development of pest survey manuals, compendia and databases to enhance quarantine capabilities
- Reducing postharvest losses and ensuring quality in smallholder systems for fruit, grains, legumes, animal feed and coffee
- Interventions to enhance the food safety and marketability of horticultural crops, particularly through supply chain analysis of tropical fruit

Forestry and natural resource management

- Development of technologies for fast-growing forest plantations for high and sustainable productivity, growing especially *Eucalyptus*, *Acacia* and *Pinus*, on degraded soils in northern and southern Vietnam
- Improvement of plantation wood processing efficiency, especially for small eucalypts and acacias through small-scale sawing, drying, preservation, and use of composites
- Use of indigenous tree species with high timber and non-timber forest product values and for rehabilitation of natural forests and conservation of biodiversity
- Sustainable cultivation techniques, including recycling of organic matter, to develop agriculture and agro-forestry on poor sandy soils in central coastal Vietnam
- Development of land-use practices to minimise the negative impacts to the environment on sandy and acid sulfate areas

ACIAR publications

This list is a selection of titles from ACIAR's range of scientific publications that have relevance to Vietnam's agricultural research and development sector. Hard copies are available from ACIAR's Vietnam office, or by emailing comms@aciar.gov.au. Titles marked with an asterisk may also be downloaded from ACIAR's website, www.aciar.gov.au.

Monographs

32 Working with Mycorrhizas in Forestry and Agriculture
48 Nutrient Disorders of Sweet Potato
54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries
57 Haemorrhagic Septicaemia
58 Understanding Animal Health in Southeast Asia
59 Ecologically-based Rodent Management
62 Developing Forage Technologies with Smallholder Farmers: How to select the best varieties to offer farmers in Southeast Asia (available from CIAT: www.ciat.cgiar.org/asia) (Vietnamese edition available)
74 Nutrient Disorders in Plantation Eucalypts
82 Controlling Newcastle Disease in Village Chickens: A Field Manual
83 How to Unravel and Solve Soil Fertility Problems*
86 Controlling Newcastle Disease in Village Chickens: A Training Manual
87 Controlling Newcastle Disease in Village Chickens: A laboratory Manual
88 Developing forage technologies with smallholder farmers: How to grow, manage and use forages (available from CIAT: www.ciat.cgiar.org/asia) (Vietnamese edition available)
94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package*
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