

Country Profile

Vietnam

November 2005

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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GPO Box 1571 Canberra ACT Australia 2601

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Additional copies of this publication are available from ACIAR offices—

In Vietnam:

Ms Misha Coleman
Country Manager Vietnam
Tel: 844 831 7755 Ext 202
Fax 84 4 831 7707
Email: misha.coleman@dfat.gov.au
Postal address:
Australian Embassy
8 Dao Tan Street
Ba Dinh District
Hanoi Vietnam

In Australia:

Communications Program Manager
Tel: 61 2 62170500
Fax: 61 2 6217 0501
Email: comms@aciar.gov.au
Postal address:
GPO Box 1571
Canberra ACT 2601

Website: www.aciar.gov.au

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Preface

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 2005. At that time there were 33 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 2005–06 financial year.

This publication also sets out the key outputs and outcomes from 2 bilateral projects that have been completed since 30 June 2005.

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 2004–05 Annual Report covering Vietnam, and our near-term program as set out in the 2005–06 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

November 2005



Misha Coleman
ACIAR Country Manager, Vietnam
misha.coleman@dfat.gov.au

Vietnam report 2004–05

(extract from ACIAR Annual Report 2004–05)

Active projects in 2004–05	34
AOP budgeted expenditure in 2004–05	\$3,060,000
Actual bilateral country expenditure in 2004–05	\$2,983,069
Bilateral country expenditure in 2003–04	\$2,069,638
Bilateral country expenditure in 2002–03	\$2,212,809

Key performance indicators	Performance 2004–05
<ul style="list-style-type: none"> Four new projects start with a central Vietnam focus, linking with research institutes in major cities 	Four projects—groundwater access, crop diseases, mud crab diets and tropical spiny lobster—commenced.
<ul style="list-style-type: none"> Strong linkages between three projects on fruit production, crop protection and postharvest technologies in the NW highlands of Vietnam 	Linkages between four projects: low-chill fruit production, postharvest disease and quality management, strengthening market information, and managing pest fruit flies.
<ul style="list-style-type: none"> Consolidation of AusAID-funded training of Vietnamese scientists in fish nutrition through the implementation of two new ACIAR projects 	New projects with a nutrition focus, mud crab diets and tropical spiny lobster aquaculture to consolidate earlier capacity-building in fish nutrition under the AusAID-CARD program.
<ul style="list-style-type: none"> Advancement of hybrid acacia technologies into routine tree breeding programs 	Hybrid acacia plantations in Vietnam now stand at over 150,000 hectares, with deployment of hybrids based on technologies initially developed with ACIAR support.
<ul style="list-style-type: none"> Use of pesticide and mycotoxin tests for export crop certification 	Certification methods used to match the requirement of the import partner, with two tests accepted for export certification, and officially recommended by Vietnamese Government.
<ul style="list-style-type: none"> Extension of disease management strategies for durians to farmers 	National distribution of the phosphonate treatment introduced controls of phytophthora in durian, with cultivation of 6000 ha by 4500 farmers, half of whom are hill tribe minorities.

Position

ACIAR's program in Vietnam has evolved since it first began in 1993, when the focus was on capacity-building through project activities. Training still remains an important facet of activities, but the main focus of the program has shifted to practical farmer help and policy impacts. A secondary component of project design is building linkages from the main research centres in Ho Chi Minh City and Hanoi to regional institutes. The new regional focus for these activities is central Vietnam, particularly central coastal regions. Projects in Vietnam may also involve other Mekong countries, covering issues that are common to these partners.

The strategic emphasis of the current program involves boosting smallholder incomes through research that targets crop and livestock diversification within existing farming systems. Improving market access is a focus, including strengthening the comparative advantages Vietnam has in some commodities for both domestic and export supply. Options for the development of rural agricultural enterprises, including efficiencies of cooperative production and marketing, are being addressed. Improved natural resource management and their sustainable utilisation are also research focal points.

Achievements

Rice and maize are the two most important crops in Vietnam, with soybean the third largest crop. A major factor inhibiting increased yields is poorly adapted soybean lines. A dual approach **has been adopted to introduce improved lines**, focusing on testing varieties for their suitability to local conditions and examining agronomic practices. Varieties tolerant to major environmental stresses and adapted to local conditions (such as the shorter sunlight duration during the winter months when soybean is planted) were introduced. The best of these are expected to be released commercially.

Three other projects are also **addressing improvements to cropping systems**. A newly commenced project is examining the use of growth-promoting rhizobacteria for use in improving nutrient availability in soils used for rice cropping. The first year of research introduced more sustainable soil management practices in upland areas. Soil sampling was undertaken at two sites and the major constraints, including acidic soil types, were identified. An acidification risk map has been developed and is being used to build up soil capability classification, to help choose the appropriate crop and best management techniques. These data are being fed into the Vietnam soils component of the World Vision–ACIAR joint project to **extend the results of past research to farmer groups**. World Vision is also extending the trap barrier system technology to communes to help reduce rice losses from rodents, and is changing fertiliser and soil management practices in peanut cropping.

Control of huanglongbing (Asian citrus greening disease), a major constraint to citrus production, is being investigated. The project, operating in Indonesia and Vietnam, is developing management strategies for both the disease and its vector, the Asian citrus psyllid. Initial results indicate **oil sprays as a likely control option**. Research to control several significant diseases of citrus continues, with collections being screened to identify resistant varieties. Trials have been established at several locations.

Fruit fly management is vital to effective horticulture and vegetable cropping. Collection of species across the country has so far confirmed that nine species of fruit fly are major pests. Training of 290 extension staff from the Provincial Plant Protection Department has equipped them to introduce improved management options to 4400 farmers across Vietnam. This includes managing insecticide-laced protein baits manufactured by a local brewery from brewery waste. More than 5000 **copies of farmer extension materials have been circulated** to other Vietnamese research agencies. Trials involving farmer groups have successfully suppressed fruit fly populations to where fruit damage is minimal.

A joint Thai–Vietnamese collaboration is examining the use of green ants to control mango pests. Introductions of the green weaver ant continue to be trialled, and **low and high technology solutions** to controlling the ant's aggression during fruit harvesting are under development. An added bonus of using weaver ants in combination with low-impact, targeted chemicals as part of an integrated pest management package is improved fruit quality and marketability.

Better controls against fruit flies pay off

Vietnam's smallholder fruit farmers have become accustomed to losing significant parts of their crops to fruit flies. In northern Vietnam up to 95 per cent of each year's peach crop is destroyed by these pests and Barbados cherry production in the Mekong delta region can suffer similar losses.

Long Thuan, a village in southern Vietnam's cherry growing region, has been part of a trial of an approach to managing fruit flies that is new to Vietnam—the use of treated brewery waste, which with addition of an insecticide attracts and kills pest species. Since beginning the trial returns on sales of cherries have doubled.

For villagers like those in Long Thuan and other areas of the Barbados cherry growing district of Go Cong, the only proven deterrent was chemical cover sprays, capable of causing problems for human health and the environment. These sprays often kill other invertebrates including natural predators of the fruit fly.

The use of brewery waste is a far more environmentally friendly approach. Treating this waste with heat and enzymes converts it to a protein that is highly attractive to fruit flies. The protein is diluted with water and a miniscule amount of insecticide added. The mixture is applied as a spot spray on a tree, sufficient to attract and kill flies.

The experts from Griffith University's International Centre for Management of Pest Fruit Flies helped to devise a survey to determine the local fly species and susceptible host fruit species. This was important for getting the formulation of the bait right and to develop an understanding of the target host crops.

Once this was achieved the research team sought partners to build a processing plant. BASF (formerly Aventis) provided funding channelled through the Crawford Fund, and Fosters Vietnam agreed to build a plant to process the waste into protein baits. The plant opened in April 2004 and since then fruit farmers in Vietnam have been trialling the bait.

Since they began the trials Long Thuan's farmers have benefited from dramatic rises in yields—and incomes. Where previously farmers sold their cherries through a middleman for only 1500 VND/kg, they are now able to obtain 3000 VND/kg. Even greater increases in yields and incomes have been reported by minority H'Mong peach farmers using the new protein bait spray technology in northern Vietnam's Moc Chau district.

Two livestock systems are under study. Pig meat production in Vietnam relies on smallholder farmers who supply 80 per cent of all pigs. High feed costs reduce profit margins and encourage smallholders to feed pigs less than optimal diets. The **lack of protein restricts growth rates** and increases time to sale. A range of feedstuffs is being assembled and analysed for positive nutritional components and also for negative elements such as toxins. One foodstuff under investigation is rubber seed meal with initial indications suggesting appropriate agronomic management of selected varieties could provide a low-cost feed option and produce better rubber seed oil for sale. A similar approach to increasing beef production in central Vietnam is also being undertaken, with researchers aiming to characterise the nutritive value of a variety of feed options.

A project operating across a number of countries, including Vietnam, is collating a range of **information on tropical forage species** for use in a computer-based selection tool known as SoFT—Selection of Forages for the Tropics. It will make it easier to choose suitable forages for smallholder and larger-scale agricultural systems from the 120 major forage species. SoFT was launched at the International Grassland Congress in June 2005.

A project to introduce Vietnamese researchers to market analysis aims to strengthen the flow of information between Government agencies, market chains and ultimately smallholders. **Pig, vegetable and fruit canning market chains** and information channels are being examined and described. Vietnamese researchers are improving their skills in these areas by undertaking data collection, case studies and analysis. This information is being provided to the Ministry of Agriculture and Rural Development's Information Centre for Agriculture and Rural Development.

Researchers are assessing smallholder opportunities in aquaculture and agroforestry to supply products to new and emerging markets. Aquaculture enterprises of smallholders, **targeting freshwater species found in the Mekong**, are currently inhibited by poor feed quality. Prospective feed ingredients (rice bran, plant meals and locally available resources) are being assessed to develop improved diets.

Reservoir aquaculture in highland areas can help to reduce poverty. Two related projects are examining how to optimise this industry. The first is testing management practices to identify improvements in yields and sustainability by collecting information on **fisheries and reservoir dynamics** to predict yield sizes—vital information for decision-makers at national and provincial levels. Stocking density and species combinations are also being trialled for smallholder-managed reservoirs. The second project is assessing which species are economically viable from the perspectives of both farmers and marketers. This will dovetail into recommendations for policy makers to provide incentives for those entering aquaculture and help to maximise sustainable returns.

Mud crab aquaculture is a growing industry but has relied on trash fish caught as by-product during other fishing activities. Research has now formulated **improved diets** that reduce the reliance on trash fish and are better suited to the nutritional needs of rearing crabs.

The use of mixed species in agroforestry plantations can overcome time delays between planting trees and harvesting. Researchers are examining the role of different species in **providing food, income and environmental benefits from reforestation**. The financial profitability of a range of mixed species plantations is being assessed through economic modelling. Experimental trials of a variety of different species are under way to develop optimal mixes and management strategies.

Postharvest management aims to both add value and reduce losses to agricultural commodities. Vietnamese and Chinese researchers are collaborating in an ACIAR-supported project to improve grain storage. Several species of pests that attack stored grain are showing signs of emergent resistance to phosphine, the leading fumigant used in both countries and Australia. Resistant species have been characterised and revised recommendations on phosphine use developed. In villages where corn is stored researchers have introduced **a simple, easy-to-use, mobile stove to dry corn**, thus preventing mould infection and mycotoxin buildup. A new project is examining the impact of postharvest disease losses in the small temperate stone fruit industry.

Recognising the importance of agricultural extension, a project to institute an evaluation framework for research and extension activities is under way in the Ministry of Agriculture and Rural Development. This new project aims to adapt a framework developed in Australia to Vietnamese contexts. Another project has **examined the impact of changing policies towards rice production** with a major emphasis of activities focusing on capacity-building. The effects on income distribution, consumption patterns and employment from changes to these policies were all assessed. Researchers characterised issues relating to land fragmentation, land use, farm incomes and size, along with other issues stemming from policy changes, and disseminated the results through research journals and workshops.

Vietnam plan 2005–06

(extract from ACIAR Annual Operational Plan 2005–06)

GNI per capita ¹	AUD 740	Bilateral actual 2003–04	\$2.1m
Population ²	78.1 million	Bilateral forecast 2004–05	\$3.2m
Population 2025/2050 ³	104.7 / 117.7 million	Bilateral budget 2005–06	\$3.0m
Active bilateral projects	30	Multilateral budget 2005–06	\$0.3m
Active multilateral projects	2		

Medium-term 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 focus on sustainable cultivation systems for poor soils in central and southern Vietnam and on water conservation. Close linkages to AusAID-funded programs (Collaboration for Agriculture and Rural Development (CARD) and the Quang Ngai Rural Development program) will continue to be strengthened.

Key performance indicators (2005–06)

- Linkages between ACIAR-funded research and AusAID-funded development established in at least four CARD projects
- More efficient project approval procedures negotiated with Vietnamese partners
- NGO linkages established in at least one additional project
- Initial trials on low-cost pig feeds completed
- Acceptance by government standards agencies of recommendations on maximum concentrations of key heavy metals in soils and crops
- Trials on appropriate aquaculture species combinations for production in reservoirs completed and outcomes from the economics and fisheries technical projects shared
- Market information systems established for at least one commodity
- 40% of new projects designed to have significant farmer or policy-maker impacts within 5 years of completion

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, improved soil fertility management and better control of citrus pests. Many of the technologies arising from these

¹ Source: Commonwealth of Australia, *Australia's Overseas Aid Program 2005–06*, Statement by Minister Alexander Downer, May 2005.

² Source: United Nations Population Division, 2004, *World Population to 2300*.

³ Source: United Nations Population Division, 2003, *World Population Prospects: The 2002 Revision*.

projects are being applied and capacity developed in R&D and extension through the AusAID CARD program, and the commencement of a second phase in 2004–05 is enabling this to continue.

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 policy-makers and the national relevance of much of the portfolio, at the February 2004 country consultation it was agreed that emphasis on central Vietnam, particularly central coastal regions, should increase.

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

During 2005–06, new project opportunities will be explored in selected areas of agricultural economics and development policy, animal sciences, crop protection, postharvest technology, fisheries, forestry and land and water resources management. However, a number of current projects have been extended in order to increase the uptake of results by farmers and in the policy process.

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. Indicative priorities for cooperation include:

Agricultural economics and development policy

- Policy options for optimising market-oriented crop production
 - Options for development of small-scale agro-enterprises in rural areas
 - Assessment of and industry planning for possible impacts of trade agreements, particularly on the fisheries sector
 - Policy options for cooperatives in agricultural and fisheries production and marketing systems to deliver improved returns to smallholders
-
- *Livestock sciences*
 - Smallholder pig production systems including nutrition, housing, health and meeting market requirements
 - Smallholder production of ruminants within crop–livestock systems, including nutrition, genotype assessment and management
 - Incentives and regulatory issues for improved animal waste management in peri-urban areas
 - Policy and technical research to complement other donor interventions on highly pathogenic avian influenza and other zoonotic diseases

Fisheries

- Cost-effective and environmentally friendly aquaculture feeds
- 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 safety and marketability of horticultural crops, particularly through supply chain analysis of tropical fruit

Forestry

- Development of technologies for fast-growing forest plantations for high and sustainable productivity on degraded soils
- 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

Natural resource management

- 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
- Application of water-saving technology and nutrient management systems in production of rice and other crops

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; writing for scientific, extension, farmer and government audiences; and collection and analysis of market information.

Program Adviser

Dr T K Lim

Key program managers

Dr Ray Trewin, Agricultural Development Policy
 Mr Barney Smith, Fisheries
 Dr Russell Haines, Forestry
 Dr Ian Willett, Land and Water Resources
 Dr Bill Winter, Livestock Production Systems
 Dr Greg Johnson, Postharvest Technology

Country Manager

Ms Misha Coleman, ACIAR Country Manager, Vietnam

Active projects

30 June 2005

Bilateral

ADP/1997/092	Impacts of alternative policy options on the agricultural sector in Vietnam	17
ADP/2000/018	The economics of developing reservoir aquaculture in Vietnam	19
ADP/2001/066	Strengthening agricultural market information activities in Vietnam	21
ADP/2002/015	Managing groundwater access in Tay Nguyen (Central Highlands Vietnam)	23
CIM/1995/130	Soybean variety adaptation and improvement in Vietnam and Australia	24
CIM/1998/061	Coconut tissue culture for clonal propagation and safe germplasm exchange	26
CP/1997/079	Integrated control of mango insect pests using green ants as a key element	28
CP/1998/005	Managing pest fruit flies to increase production of fruit and vegetable crops in Vietnam	30
CP/1998/018	Bioherbicide development for cereals in integrated weed management	32
CP/2000/043	Huanglongbing management for Indonesia, Vietnam and Australia	34
CP/2001/027	Adaptation of low-chill temperate fruits to Australia, Thailand, Laos and Vietnam	36
CP/2002/115	Diseases of crops in the central provinces of Vietnam: diagnosis, extension and control	38
CP/2005/035	Survey toolbox for plant pests - A practical manual for surveillance of agricultural crops and forests	39
FIS/2000/065	Assessing the potential for low cost formulated diets for mud crab aquaculture in Australia, Indonesia and Vietnam	40
FIS/2001/013	Culture-based and capture fisheries development and management in reservoirs in Vietnam	42
FIS/2001/058	Sustainable tropical spiny lobster aquaculture in Vietnam and Australia	44
FIS/2002/068	Improving feeds and feeding for small scale aquaculture in Vietnam and Cambodia	45
FIS/2002/077	Improved hatchery and growout technology for marine finfish in the Asia-Pacific region	47
FIS/2003/003	Stock structure of two important Mekong River carp species (Hemicorynchus spp.)	49
FIS/2005/030	Dissemination of findings on the "best practice approach" to culture-based fisheries through a series of workshops in selected developing countries in Asia	51
FST/1994/019	Genetic diversity and propagation of mangroves	52

FST/1999/095	Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and silviculture	54
FST/2000/003	Mixed species plantations of high-value trees for timber production and enhanced community services in Vietnam and Australia	55
FST/2003/002	Development and evaluation of sterile triploids and polyploid breeding methodologies for commercial species of Acacia in Vietnam, South Africa and Australia	57
LPS/2002/078	Improved beef production in central Vietnam	59
LPS/2002/079	Utilisation of local ingredients in commercial feeds for pigs	61
LWR/1998/119	Impact of heavy metals on sustainability of fertilisation and waste recycling in peri-urban and intensive agriculture in Southeast Asia	63
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LWR/2002/085	Utilising basic soil data for the sustainable management of upland soils in Vietnam and Australia	67
PHT/1998/137	Integrating effective phosphine fumigation practices into grain storage systems in China, Vietnam and Australia	69
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PLIA/2000/165	Facilitating farmer uptake of ACIAR project results: World Vision collaborative program	73
PLIA/2002/103	Enhancing project impact and science capability through ongoing evaluation	75
Multilateral		
AH/1998/054	Poverty alleviation and food security through improving the sweet potato-pig systems in Indonesia and Vietnam	77
CP/2000/002	Development of advanced technologies for germplasm conservation of tropical fruit species	79
LPS/2004/073	Capacity building on cattle production at Dong Giang district, Quang Nam province, Vietnam	81
PLIA/2000/039	Impact of migration and /or off-farm employment on roles of women and appropriate technologies in Asia and Australia mixed farming systems	82

Project 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, mobile 041 451 2574 Fax: 02 9351 4953 Email: g.macaulay@agec.usyd.edu.au
Collaborating Institutions	International Rice Research Institute, Social Sciences Division, Philippines Hanoi Agricultural University, Faculty of Economics and Rural Development, Vietnam
Project Budget	\$732,619
Project Duration	01/07/1999 to 30/09/2005 (Project extended from 01/01/2003 to 30/09/2005)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Until 1980, the agricultural sector in Vietnam was collectivised. Most land was cooperatively used, and only 5 per cent was left for individual household use. Farm decisions were made by the central government, which set areas and targets for each of the crops produced by the cooperatives which ran the farms. There was strict control over what farmers could do. As a consequence of this system, rice production fell short of population growth, leading to serious food shortages. Since 1981, the government has been implementing economic reforms to 'decollectivise' agriculture. These new policies have had considerable effect, and Vietnam is self-sufficient in rice and has become the world's third largest exporter. However, the impacts of the new policies at the farm level, on factors such as household incomes, land use, credit provision and taxation, are important questions that have had little investigation.

One of the reasons is that Vietnam lacks key personnel with experience in policy design and analysis under a market-orientated economy. However, Australian agricultural economists have considerable expertise in resolving the socio-economic problems that arise during the development process. Accordingly, this project will use Australian experience to assess the impacts of the new government policies on land use in the agricultural sector during the transformation to a market-based economy. In the process, it will deliberately provide opportunities for teaching Vietnamese staff and researchers to develop their skills in agricultural policy research, formulation and analysis. The main aims of project activities are to assess the impacts of the Vietnamese government's new policies on agriculture and to provide economic models suitable for analysing policy reforms.

Project progress

Year 5 (01/07/2003-30/06/2004)

A total of six policy analysis training courses, each of approximately five days, have been held, with four funded within the ACIAR project (135 participants) and two funded by the associated AusAID-funded CARD project (52 participants). 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. Participants came from Hanoi Agricultural University, various departments within the Ministry of Agricultural and Rural Development, and other universities and institutions in northern, central and southern Vietnam.

A substantial amount of the training course material on quantitative policy analysis has been translated into Vietnamese, available as hardcopy and on CD-ROM, and has been widely distributed.

Training course material includes a range of documented models suitable for teaching techniques for quantitative policy analysis.

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

Two successful international workshops were held in conjunction with the project. The first was held at the University of Sydney in November 2002, on the topic "Land Use in Vietnam: Policy Issues and Research". A final project workshop was held in Hanoi in February 2004, on the topic "Land Policy and Agricultural Development in Vietnam". The workshop was attended by a number of senior policy makers, academics and officials of non-government organisations. Project team members presented papers on a range of topics including land fragmentation, land consolidation, the market for land-use rights, land-use flexibility, farm incomes and farm size, price policies, supportive policies and credit use; and a number of papers were also given by external presenters.

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

Publications from the project at present include two refereed journal articles, two consultant's reports, four 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), nine conference papers, and numerous workshop and working papers. A set of four policy briefs was prepared for distribution, covering:

- 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.

Project 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 Fax: 08 6488 1098 Email: steven.schilizzi@uwa.edu.au
Collaborating Institutions	University of Agriculture and Forestry, Vietnam Research Institute for Aquaculture No. 1, Vietnam Institute of Fisheries Economics & Policy, Vietnam Deakin University, Australia
Project Budget	\$341,126
Project Duration	01/07/2002 to 30/06/2006 (Project extended from 01/07/2005 to 30/06/2006)
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 2 (01/07/2004-30/06/2005)

Surveys and model building Surveys in two phases were planned to collect data. The first phase was completed in 2004 and has provided data on the extent of variability in input and output factors, as well as in fish farming system characteristics, such as purchasing or production of fingerlings, fish feeding if any, and harvesting techniques. The second phase started in September 2004 and aims at understanding the day-to-day *dynamics* over time, and to collect the necessary data to calibrate a bioeconomic model for different aquaculture systems. Surveys focus on two types of fish for market operations: cage culture and farmer-managed reservoirs; production of fingerlings is also included. This second phase of surveys is still under way both in the north (Yen Bai and Thai Nguyen provinces) and in the south (Dong Nai and Binh Phuoc provinces). A recent government decision to ban cove culture in large reservoirs due to concerns regarding the impacts of these activities means that further investigations on this aquaculture system may have to be abandoned.

Model building A first version of "BRAVO" (**B**ioeconomic model of **R**eservoir **A**quaculture for **V**ietnamese **O**perations), was constructed during 2004 and successfully calibrated to the northern small reservoir systems, based on data provided by a related project. More data are needed before it can be calibrated to the larger systems of the south. BRAVO contains both a multi-species biological module and an economic module. BRAVO is implemented in Excel© so as to make it portable and easily usable by Vietnamese project participants. It is at this stage a simulation model and does not

optimise for species mix, stocking rates and harvesting strategies. BRAVO was presented, together with some first simulation results, at the First Project Workshop held at Nong Lam University in December, of which a report is available. These results were also presented at the 49th Annual Conference of the Australian Agricultural and Resource Economics Society in February 2005. The next stage in model development will be to include the uncertainty and riskiness of aquaculture outcomes.

Surveys of marketing systems The first phase was completed in 2004, yielding the result that marketing conditions, like production, vary widely in the sample, reflecting the early learning stages of this nascent industry. The second phase of surveys began in September 2004 and target so-called 'middlemen' (often women) who sell fingerlings and market adult fish to wholesalers and retailers. A number of local informers/surveyors have been hired for a day-to-day follow-up of fish marketing transactions, with species, quantities, prices and other marketing characteristics being recorded over a fishing season. It is expected the data should yield insights into the dynamics of price fluctuations and into differences between prices paid to fishers and prices paid by consumers.

Business plan template This has been designed with the triple goal of gathering important economic information on the riskiness of aquaculture operations; allowing operators to become aware of their financial strengths and weaknesses; and possibly reducing in the future the cost of official bank loans in terms of collateral, and so the need for exorbitant unofficial loans. The template was designed using current bank loan forms as a starting point, but focuses on production and price risks. The second phase surveys will include training of local participants to use such a template for future purposes. It is a tool aimed at roughly estimating an operation's creditworthiness, and for calibrating the next phase of BRAVO.

Data gathering The first phase surveys were completed in 2004 and targeted local authorities at the Provincial, District and Village (Commune) levels, as well as the extension services at the Provincial level. Phase two surveys will take the form of case studies and will follow completion of production and marketing phase two surveys. They will include input and feedback from local stakeholders. Aquaculture cooperative charters have begun to be translated and analysed, as well as government regulations impinging on aquaculture.

Project 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 Fax: 08 9330 1098 Email: mpburton@agric.uwa.edu.au
Collaborating Institutions	Ministry of Agriculture and Rural Development, Vietnam Department of Agriculture, Western Australia, Australia \$399,574
Project Budget	
Project Duration	01/01/2003 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
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 identify 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 - 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 2 (01/01/2004-31/12/2004)

The main activities in the past year were focussed on training in quantitative analysis, development of modelling capacity and institutional design.

Case studies Field work on fruit marketing in the northern mountainous regions will link with the associated Postharvest Technology project initiation workshop. The draft survey questionnaire and data collection strategy will be finalised after the interaction with scientists at this workshop.

International comparison for institutional design A paper entitled *Chinese Centre for Agricultural Policy: A vanguard in the Research System of China* was published as part of the Policy Briefing Series. Considerable interest has been shown in this paper by senior policy makers, as it deals with institutional reform in a government research organisation in China. It is anticipated that high ranking officials from four Ministries (Agriculture, Science and Technology, Finance and Internal Affairs) will go to China with Dang Kim Son to further study these innovations in the Chinese Research System, to be funded by the Vietnamese Govt.

It has been proposed that the new Institute for Agricultural Economics — which is where the Vietnamese project team is now based — will be modelled on the structure of the Chinese Centre for Agricultural Policy, and will represent a 'pilot project' of Institutional reform in the state research system. The ACIAR project made this exposure to Chinese institutional reform possible not only because it funded the original trip to China, but also because it provided access to ACIAR's network of research organisations in China.

Capacity building in modelling Four training courses were conducted in Vietnam over the past 12 months. Three of these were funded directly out of project funds, the fourth was funded by the World Bank:

- Farm level modelling, held at Western Australian Department of Agriculture,
- Modelling in Excel for policy analysis, held at the University of Western Australia,
- Demand analysis, also at UWA, and
- Advanced Econometrics for price forecasting, also held at UWA.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Australian National University, National Centre for Development Studies, Australia
Project Leader	Professor Jeff Bennett Phone: (02) 6125-0154 Fax: (02) 6125-8448 Email: jeff.bennett@anu.edu.au
Collaborating Institutions	Taj Nguyen University, Vietnam Ho Chi Minh City University of Economics, Vietnam Department of Water Resources Management, Vietnam
Project Budget	\$399,111
Project Duration	01/01/2005 to 31/12/2007
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

The Tay Nguyen (Central Highlands) region is Vietnam's leading coffee producer. It also supplies agricultural and forestry products for domestic markets and export. The region covers approximately 17 per cent of Vietnam's land area, including 16 per cent of total arable land and 22 per cent of forested land. In recent years drought has struck, reducing coffee production in 2003 by an estimated 25 per cent. Domestic water supplies were also threatened. Drought, however, was not the only factor in production declines and water shortages. Vietnamese Government policies have encouraged the intensification of agricultural and agroforestry practices over the past three decades. Population growth has since resulted during the same period, intensifying resource use, including water. Much of the increased agricultural production has been based on cropping, with deforestation providing cropping land and increasing water use.

Current groundwater extraction practices to support and underpin much of this agricultural expansion are unsustainable. Recent droughts exacerbated the threat to groundwater and agricultural production but were not the main cause of concern. If left unaddressed sustainable farming will collapse and the economic, social and environmental impacts, both to the region and Vietnam could be severe. Salinity and nutrient depletion, now becoming evident have the potential to be widespread, production will decline in key industries and unemployment rise. The project aims to:

- understand the dynamics of groundwater flows in the Tay Nguyen region and to employ these data to analyse the physical impacts of alternative use regimes over the forecast period,
- determine the use allocation of groundwater resources that provide for social improvements on the basis of economic, social and environmental criteria using extended cost-benefit analysis,
- consider alternative policy options for securing improved groundwater use practices and determine the most practical and cost-effective institutional framework to provide incentives for the improved use of the resource using the New Institutional Economics framework,
- facilitate the use of the research findings in the development of policy initiatives and institutional frameworks, and
- build the capacity of Vietnamese scientists and organisations involved in resource and environmental management.

Project progress

Year 1 (01/01/2005 to 31/12/2005)

The first progress report is due early in 2006.

Project 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 A T James Phone: 07 32142278 Fax: 07 3214 2730 Email: andrew.james@pi.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 31/12/2005 (Project extended from 01/07/2002 to 31/12/2005)
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Productivity of soybeans in Asia, and particularly Vietnam, is low compared with elsewhere in the world. Vietnam's average yields are 1t/ha compared with 1.3 t/ha in Thailand, 1.75 t/ha in Brazil and 2.25 t/ha in the USA. The low productivity is a problem because Vietnam needs more soybeans to satisfy a growing demand for stockfeed and to improve the nutrition of the human population.

The reasons for poor production in Vietnam have been clearly identified. One of the most significant is the fact that the varieties grown in summer have a growing period too short to produce the maximum yield possible for the season. The high seasonal rainfall usually occur when crops are maturing and this causes poor seed quality. In addition, these poorly-adapted varieties are grown at low densities to reduce the problem of lodging (plants falling or bending and becoming tangled).

Moreover, soybean is invariably treated as secondary to rice, and so receives less research attention, less fertiliser input, and less effort at insect control. This is made worse by the existing poor yields. It simply does not appear worthwhile to invest in a crop that gives poor financial returns. For this reason, soybean is grown using natural rainfall, and short-duration varieties that make use of this are chosen. These varieties naturally have a low yield potential. Higher-yielding varieties, better suited to the conditions in the growing areas of Vietnam, are seen as one of the main ways of solving this problem. At the same time, improved varieties and knowledge are likely to benefit the small soybean-growing operation in Australia and expand the experience of the Australian project team in a previous soybean improvement project in Thailand. The project aims to enhance the yield and quality of soybeans in Vietnam and Australia by developing suitable cultivars for immediate use by growers, along with improved agronomic management methods.

Project progress

Year 6 (01/07/2004-30/06/2005)

Long Juvenile Trait The long juvenile (LJ) trait extends the time to flowering by about 10 days, depending on temperature, without affecting sensitivity to photoperiod. When inserted into photoperiod-insensitive, short duration cultivars, it has the potential to extend crop duration and increase yield potential, without introducing photoperiod sensitivity. Such lines have potentially wider adaptation over seasons and latitudes. In the first phase of the project, the line 95389 was derived by combining the LJ trait with an early maturing variety from Thailand. It remains unclear whether different alleles exist for the trait and if so, the nature of its inheritance. Five soybean genotypes with potentially different sources of LJ alleles have now been identified. Hybrid crosses have been made between the five putative LJ sources and different short duration lines, and grown through the F1 generation in Brisbane. F2 plants of 15 of the crosses are now being evaluated in the field in north

Queensland. The modelling component on regional and seasonal effects on phenology is being undertaken.

Germplasm Exchange As part of the project extension, a set of advanced breeding lines from the Australian program has been provided to collaborating Vietnamese organisations for inclusion in ongoing national and regional varietal programs. Seed of 50 advanced lines, selected from several populations in the CSIRO program on the basis of their potential utility in Vietnam, was multiplied and delivered to VASI, HAU, IAS and CAFTNU in November 2004. Evaluation of these lines is now underway outside the project, in the context of the ongoing soybean improvement programs within each of these organisations.

Seed Production During the first phase of the project, several lines were identified as potentially suitable for release to Vietnamese farmers. VASI has now decided to release line 95389 as 'DT21'. Apart from its high yield potential, an advantage of this variety is that it can be grown year-round. This simplifies the supply of good quality seed from one season to the next. Seed production of DT21 was initiated in Ha Tay province, with a small plot of winter season production contracted to the Ung Hoa Cooperative. In addition, seed production organisations (communes, cooperatives and other NGOs) have been lined up in another 10 provinces to undertake seed production once sufficient seed supplies become available. The immediate focus is on Ha Tay and Hung Yen provinces, where there is potential for irrigated winter season production. Smaller areas of winter crop will be targeted in Ha Nam and Bac Ninh provinces.

Project 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 Fax: 07 3365 1177 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 Banos, Philippines Oil Plants Institute of Vietnam, Vietnam
Project Budget	\$711,309
Project Duration	01/07/2002 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
ACIAR Research Program Manager	Mr John Cullen

Project background and objectives

Coconut is the most important palm of the humid tropics and 96% of the crop is grown by resource-poor smallholders. Its traditional products are copra, coconut oil and copra meat, but it also has the ability to produce a wide variety of food and environmentally friendly non-food products which are used domestically and for export. The coconut palm has also been a stabilising factor in the farming systems of marginal and environmentally fragile environments.

The worldwide production of coconut has not increased in decades, due to the lack of new genetic stocks, devastation of crops from pests and diseases and rapid loss of precious coconut germplasm. Few of the coconut producing countries have the capacity to characterise and evaluate the field performance of conserved germplasm. Many of these countries also lack the capacity to exchange disease-free germplasm with other coconut producing countries because they are unable to undertake embryo culture, they do not have a capability to index diseases and their germplasm export clearances are tedious.

This project aims to find an improved technique for coconut embryo culture which is suitable to re-establish palms from internationally exchanged and cryopreserved embryos. It will continue existing research on the embryogenesis from somatic tissues and develop a protocol for the rapid production of true-to-type clonal palms. It also aims to develop a technique to genetically analyse plants that have been developed from clonal propagation, embryo culture or cryopreservation. All the coconut biotechnological techniques that will be gained from this project will be transferred to the partner countries in this project.

Project progress

Year 3 (01/07/2004-30/06/2005)

The physiological quality of the embryo used for tissue culture work is an important factor that, in part, determines the rate of seedling production from those embryos. Recent studies have shown that bigger embryos produce more healthy seedlings than the smaller ones. The efficiency of the embryo culture system has been further improved with a step that screens out all of the non-viable embryos from the tissue culture system after 6 to 10 weeks of culture. Reducing the medium carbohydrate load at the last seedling subculture step has been shown to have no negative effects on its subsequent growth but this action does reduce the chance of the seedlings becoming infected and performing poorly at a later stage of growth. Auxins applied at various times during the early steps of the embryo culture procedure were found to increase root production and this resulted in greater ex vitro seedling vigour. Removal of the haustorial tissue during the early steps of embryo culture was also able to improve seedling growth and ex vitro establishment. A simple acclimatization method, using a

wooden box with a transparent plastic sheet lid, produced better quality seedlings than those produced using the traditional inverted plastic bag system presently used for seedling production.

Other results have shown that as early as 3 months into the in vitro culture procedure seedlings are capable of autotrophic growth if their roots are able to access a Hoaglands nutrient solution. However, the subsequent growth of these nutrient-nurtured seedlings was often slower than that seen for seedlings growing in the traditional way. Finally, CO₂ enrichment around young seedlings growing in nutrient solution, could promote seedling growth back to that seen in the control. This action was able to cut the time in vitro from 12 to about 3 or 4 months. This represents a massive saving in culture cost and time. Earlier work demonstrated that embryo transplantation is a possible method for producing seedlings from isolated embryos using surrogate nuts as nurturing hosts. This work, undertaken in Australia on poor quality supermarket nuts is now being repeated using quality fruit and embryos in Indonesia (ICOPRI). At this stage, there has been some difficulty in germinating the transplanted embryos in the surrogate host nuts with contamination hard to contain. A seed priming method is now being used to promote the germination of the transplanted embryo. At this stage >200 primed embryos of Palu Tall have been transplanted into either Mapanget Tall or Palu Tall.

Among inflorescence calli types identified, white, round and shiny, smooth surfaced ones are more likely to be highly embryogenic than rough surfaced, friable calli masses. Multiplication of these highly embryogenic calli masses is possible by cutting the cultures into smaller pieces and culturing them and doubling the casein hydrolysate concentration. ABA was found to be useful in promoting the formation of somatic embryos when applied 1 month later, to either on pointed structures or pointed embryos. These ABA-treated embryos showed further development when they were subcultured onto an ABA-free medium where they germinated at a rate of 4.5 per cent.

A protocol to test the genetic fidelity of plants coming from tissue culture has now been developed and used to study 20 clonal plants. Results indicate that the clones analysed in this project are genetically similar at the DNA nucleotide and methylation level following their production by somatic embryogenesis. Training was undertaken at UQ attended by three participants: from PNG, Dr. Pablito the Philippines and Vietnam. The training covered all of protocols used in all of the research programs of the project, with an emphasis placed on those used in the embryo culture program particularly the use a CO₂ fogging step to improve physiological health and growth of in vitro growing seedlings prior to their establishment in soil. Other training activities were also undertaken at OPI, ICOPRI Indonesia and PCA the Philippines.

Project 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: 61 8 8946 6706, 08 8946 6666 Fax: 61 8 8946 6847 Email: kchristi@cdu.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 T K Lim

Project background and objectives

Mangoes are an important smallholder and commercial crop in Vietnam, Thailand and other Southeast Asian countries, and one of the most important commercial crops in northern Australia. To achieve good yields with top quality fruits, mango growers currently rely on regular pesticide applications. This leads to increased costs, the reduction of natural predators and parasitoids on the insect pests, increased pest resistance to insecticides, pesticide residues in the fruits and environmental pollution.

Green ants are efficient predators of a wide range of insect pests in many tropical fruit crops and they are abundant and widely distributed in Southeast Asia. Previous work in Indonesia and preliminary results from cashew crops in northern Australia indicates that green ants can control some of the main pests of mangoes.

Experiments in a mixed-cropping mango orchard using the ants together with limited applications of insecticides indicate that an integrated pest management (IPM) model for mango orchards can be constructed. Since Vietnam, Thailand and Australia all share similar insect pests of mangoes their exists common ground for collaborative research amongst the three countries.

The project aims to develop an IPM program by using green ants as a major biological control agent together with agricultural strategies and the selective use of insecticides to reduce populations of homopteran pests in mangoes in Vietnam, Thailand and Australia.

Project progress

Year 4 (01/01/2004-31/12/2004)

In Vietnam and Thailand, the yield and the fruit quality produced in the treatment with weaver (green) ants plus environmentally friendly soft chemicals (WPS) were similar to or higher than in the chemical insecticide treatment (CI), while in the Northern Territory, Australia, the profit from WPS or from trees with abundant weaver ants was increased by over 70 per cent compared to the profit in CI or in trees without weaver ants.

Compared to chemical insecticides, weaver ants were effective in controlling the major mango insect pests. These include mango leafhoppers, thrips, fruit spotting bugs, flower caterpillars, seed weevils, fruit flies, elephant beetles, stem borers, planthoppers, leaf cutting weevils, web caterpillars and seed borers.

Although weaver ants have a mutual relationship with scales and mealy bugs, the soft chemicals were effective in reducing the populations of these pests, and these soft chemicals are safe for weaver

ants. Weaver ant formic acid caused black spots on fruit skin mainly due to ant fights between colonies. Separation of weaver ant colonies is effective in reducing the levels of fruit damaged by the formic acid.

Weaver ants are aggressive, annoying people working in orchards during harvest. Water spray can greatly reduce the ant activity prior to harvest, and it does not cause fruit lenticels or post-harvest diseases. Mango growers are pleased with this method in Australia. In Thailand, farmers found a picking pole or net with a long handle plus shaking action after a few picks to be useful to reduce the disturbance from the ants. In Vietnam, two methods are used to reduce ant disturbance: rubbing wood ash on the main branches of the relevant part of the tree to break ant trails when harvesting; and luring the ant away from the trees, which will then be harvested or pruned.

Weaver ants do not have a detrimental impact on the level of parasitism of Homopteran pests in mango orchards. The mixed cropping orchards harbour more natural enemies of the insect pests compared to the monoculture orchards. To stabilise weaver ant populations in mango orchards, it is essential to isolate the ant colonies, transplant ant colonies with queens and mix mango trees with other tree crops such as citrus. If mango orchards are monoculture, the provision of ant food is needed when trees are in dormancy.

Two types of IPM programs for both organic and conventional growers have been successfully developed for mango growers in Vietnam, Thailand and Australia. These IPM programs are friendly to the environment, and they allow mango growers to significantly cut chemical insecticide use and to produce insecticide-free or organic fruits.

Educational materials targeting farmers (Booklets, video (DVD and tapes) and a series of posters) in English, Vietnamese and Thai have been produced to describe how to use the IPM program step by step. The research group is actively involved in publications, communications, dissemination and extension activities. Throughout this project, the project staff have produced 10 publications, 18 research presentations and 5 major research reports, and they have also conducted 8 major communication and extension activities.

Farmers in Vietnam, Thailand and Australia who are involved in this project are happy with the IPM programs, and they have adopted the methods. The Pest Management Center in Khon Khan Province, Thailand tried the IPM program in 2004, and they achieved better results than they expected. They will continue to use weaver ants for their oriental fruit fly research in Udorn Thani Province. The owner of the Supan Buri site, Department of Agricultural Extension of Thailand was happy with the yield, and the mango growers nearby expressed their willingness to use the ants in their orchards.

Project 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, mobile 0417 729 356 Fax: 07 3875 3697, 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 T K Lim

Project background and objectives

Fruit flies are the most damaging invertebrate pests of agriculture throughout Southeast Asia and the Pacific region. They are a major problem in Vietnam, where 70 per cent or more of many fruit crops are lost to fruit fly damage. In addition, the presence of fruit flies in any country adversely affects its trade because of severe quarantine restrictions imposed by importing countries. In Vietnam, the total area planted to horticulture is increasing as part of the government's bid to achieve food security and improve nutrition but, mainly because of fruit flies, productivity remains low and quality is poor. Given the largely benign soil and climate conditions, productivity could be increased considerably. For example, the average yield of oranges per hectare in Vietnam is only 5.7 tonnes, compared to 33.2 tonnes in Australia.

There are at least four main pest species involved in Vietnam, and these attack almost all fruit and many vegetable crops throughout the region. The flies lay eggs under the skin of the fruit and the growth of the resulting maggots destroys the fruit or severely damages it. The country's principal fruits (banana, citrus and mango), most tropical fruit and the recently introduced temperate stone and pome fruits are all attacked. In an attempt to control the problem, the Vietnamese have been using cover sprays of persistent insecticides. However, chemical residues remain in food products and in the environment. Widespread insecticide use can also kill beneficial invertebrates, such as the natural predators on fruit flies and aphids.

An alternative to heavy chemical usage is the protein bait spray method of control. This consists of attractive protein (a bait for flies) laced with a small concentration of insecticide, sufficient to kill the flies within about 1-2 days. About 50 mL of bait per tree is placed on the leaves. The method is inexpensive and easy to apply (no spraying equipment is required), and has been tested in Australia, Malaysia, Thailand and, recently, parts of Vietnam. The quantity of insecticide added to the environment in this way is negligible. The main requirement is a source of cheap bulk protein, and this will probably come from discarded brewery yeast, the country's main brewery having signalled that it is willing to provide it. The project is determining the major pest fruit fly species, and their preferred fruits, in each region of Vietnam to introduce suitable pre-harvest control by bait-spraying.

Project progress

Year 3 (01/07/2004-30/06/2005)

Continued collections of adult fruit flies collected from male lure traps and reared from host fruits (cultivated and wild) over various provinces covering north, central and south Vietnam have not revealed any new pest species beyond the nine that have so far, in the project, been identified as being 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*. In the current sampling period, however, *B. correcta* has also been recorded in North Vietnam where it was not recorded before. Crop losses ranging from 40 - 100 per cent are still being recorded in a wide range of fruits and vegetables when no control measures are applied.

Laboratory colonies (rearing on artificial diet) of *B. cucurbitae* at the National Institute of Plant Protection (NIPP) and *B. correcta* and *B. dorsalis* at the Southern Fruits Research Institute (SOFRI) continue to be maintained. 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 protein bait production plant at Foster's Tien Giang has been fully commissioned. It was officially launched together with the bait called SOFRI PROTEIN in April 2004 by the Australian Ambassador to Vietnam, the Hon Joe Thwaites. The high profile ceremony was attended by senior officials from the Tien Giang provincial government, Ministry of Agriculture and Rural Development Vietnam, Fosters Brewing International, Griffith University, Queensland Government, AusAID and ACIAR.

The one-day training program for farmers on the biology and control of fruit flies for Provincial Plant Protection Department staff, as well as for farmers has been successfully continued. In South Vietnam, training in this reporting period has focussed on Barbados Cherry farmers with whom a large area fruit fly control program is being organised. Over 4,000 copies of farmer extension leaflets have been printed and distributed by NIPP and SOFRI.

To ensure more effective control of fruit flies, two large-area fruit fly control programs have been implemented, one on peach grown by minority hill tribe people in Moc Chau, North Vietnam, and the second in Barbados cherry grown largely in Tien Giang province in South Vietnam. These trials combine the use of male lures with SOFRI PROTEIN bait sprays for more effective fruit fly population suppression. Farmers are organised in large groups of 25 or more and apply these treatments in a coordinated manner. Initial results show excellent suppression of pest fruit fly populations and very low levels of fruit damage to the benefit of a large number of farmers in an area.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	NSW Department of Primary Industries, Australia
Project Leader	Dr Bruce Auld Phone: 61 2 6391 3826 Fax: 61 2 6391 3899 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 30/07/2007 (Project extended from 01/07/2002 to 30/07/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The world's principal food crops are members of the grass family, which also contains many unwanted weeds that grow in the crops. The cost of these weeds is high, both in Australia and Vietnam, because they reduce potential yields considerably. Control using chemical herbicides is difficult and expensive. In many countries, including Vietnam, much weeding is instead done manually — a laborious task usually carried out by women, using up time that could be more usefully spent. In addition, if synthetic chemical herbicides are used, as in some areas in the south of Vietnam, the herbicides may affect the production of fish in the rice paddies and may also contaminate the water collected for drinking. The development of resistance by the weed - especially if, as with rice, three crops and therefore three sprayings per year are necessary - is another potential problem.

An alternative approach to controlling grassy weeds is the concept of bioherbicides. These are applied like conventional herbicides but the active ingredient is a naturally occurring microbe — usually a fungus. Such bioherbicides are very specific, so there is less risk of damage to non-target plants, and they also multiply on the target species, so there is less contamination of products and the environment. In addition, the bioherbicide does not persist in the environment beyond the target plant. There has been little work on bioherbicides in tropical countries, even though the warm, moist conditions suggest that this concept would be more successful in the wet tropics than in dry temperate areas. A previous ACIAR project (CS2/1994/002) identified the major suitable fungal pathogens of the principal rice and wheat weeds. This project built on this work, by developing bioherbicides from the identified fungi. The main aim of the project is developing fungal pathogens into commercial herbicides which can be used against major crop weeds in Vietnam and Australia.

Project progress

Year 6 (01/07/2004-30/06/2005)

In Vietnam, two major grass weeds were targeted for control by bioherbicides. These were barnyard grass, *Echinochloa crus-galli*, and red sprangletop, *Leptochloa chinensis*. Specific fungal pathogens of these plants were discovered in Vietnam in a previous ACIAR project. These fungi, *Exserohilum monoceras* for barnyard grass and *Setosphaeria rostrata* for red sprangletop, showed potential for development as bioherbicides. Shade-house experiments with these fungi confirmed their suitability and techniques for their mass production were investigated.

The red sprangletop bioherbicide, was successful in large scale repeated experiments at Cuu Long. Mass production methods for this fungus have been achieved using cheap materials, including rice husks. Cuu Long Rice Research Institute intends to register this bioherbicide as a product with the Vietnamese government and develop it into a practical product for rice farmers. In repeated large scale field experiments at Hanoi and Haiphong, the barnyard grass bioherbicide proved to be insufficiently virulent to warrant further development.

In Australia, research concentrated on wild oats, *Avena fatua*, the worst weed of wheat throughout the world. The fungus *Drechslera avenacea* was identified in a previous ACIAR project as the most suitable pathogen found in Australia to develop as a bioherbicide for this weed. However glasshouse experiments demonstrated that wild oat plants had considerable ability to recover from infection. Moreover, controlled environment experiments indicated that low temperatures in the field at the time of application of the bioherbicide would severely limit its potential to cause significant infection.

Subsequently, research in Australia was directed towards finding potential bioherbicides for the other major grass weed of wheat, annual ryegrass, *Lolium rigidum*. Extensive surveys and pathogenicity testing failed to discover a potentially useful fungus to develop as a bioherbicide.

Project 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: 61 2 45701287, mobile 0414531879 Fax: 61 2 45701314 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 T K Lim

Project background and objectives

Huanglongbing is a citrus disease caused by the proteobacterium *Candidatus Liberibacter asiaticus* and spread by the Asiatic citrus psyllid *Diaphorina citri*. The disease is a serious impediment to citriculture in Asia because it can destroy orchards within five years of planting. Huanglongbing was first seen in India and Pakistan in the 1800s, but has been gradually moving eastward through tropical and subtropical Asia. Despite the application of hazardous and expensive pesticides, the disease has prevented the establishment of viable citrus industries, seriously affecting the welfare of farmers and national economies. It is also a threat to biodiversity through the loss of citrus species and citrus relatives that are endemic to the region. Vietnam and Indonesia are particularly affected. Complete control of huanglongbing is not possible, but a better understanding of the vector could be used to minimise vector populations and disease transmission, and to optimise the role of natural enemies within sustainable integrated crop management programs.

Huanglongbing and *D. citri* do not occur in Australia, but there is a high risk that they could be introduced by natural and unintentional human-assisted spread through Indonesia and Papua New Guinea on known and possibly alternative hosts.

The aim of the project is to improve citrus productivity in Indonesia and Vietnam by studying the transmission and management of the citrus disease huanglongbing. A further aim is to develop management strategies for the Australian citrus industry in the event that the disease enters Australia.

Project progress

Year 2 (01/01/2004-31/12/2004)

During 2004, significant progress was made in overcoming setbacks stemming from the impact of international events. Field sites were established for a major objective in Vietnam in which management strategies (including use of white mineral oils and imidacloprid, a systemic insecticide) for control of huanglongbing and its vector, the Asiatic citrus psyllid *Diaphorina citri*, are being compared. Screenhouse studies on the effectiveness of imidacloprid were also undertaken in northern Vietnam. Progress was also made towards resolving crucially important issues related to the identity of true species of *Citrus* and *Citrus* relatives in Vietnam. These issues arose in 2003 when it became clear that published descriptions of these plants are in many instances of questionable accuracy and not supported by 'voucher' specimens in herbariums. These issues are important for management of the disease and conservation of unique plant material.

In Indonesia, controlled environment and screenhouse facilities required for research and propagation of plants were completed in July and became operational in September-October. Personnel required

for each of the project objectives were chosen in April and they commenced work in July. Sites for major field experiments were selected at three altitudes (50, 650 and 1300m above sea level). These sites will be used to assess management practices and the impact of climate on levels of infestations of the vector and the rate of spread of the disease. Initial controlled environment studies on the impact of oil white mineral oil deposits on the feeding behaviour of the vector indicated that deposits of 0.25% to 2% sprays significantly reduce feeding. Confirmation of these results will boost our confidence in the use of oil sprays to reduce transmission of disease through control of the psyllid (based on ACIAR CS2/1993/005 in China, ACIAR CS2/1996/176 research in Sarawak (East Malaysia), and subsequent research in Sarawak) and reduced feeding by adult psyllids. This should apply particularly to situations where it will be possible to maintain populations of the psyllid at low or negligible levels, such as in large orchards or smaller orchards in areas/localities with common management strategies.

The annual project planning and review workshop was held from 22-26 November in Yogyakarta. It was attended by more than 10 participants from Indonesia, four from Vietnam, three from China, one from Japan and three from Australia. Highlights of the workshop were presentations by Indonesian personnel, a valuable review of research on the disease and the vector in China, and preliminary evaluation of a simple field microscope for detecting disease-damaged tissue in leaves. This technique should prove very practical for field use, and as an alternative to expensive molecular techniques that can only be used in laboratories. It was originally used in Indonesia 20-30 years ago and its usefulness appears to have been overlooked with recent focus by scientists on the use of molecular techniques. The disease leads to degeneration, and ultimately premature death, of cells (known as phloem) that transport sugars and other chemicals in plants. In Indonesia, the disease is known as 'citrus vein phloem degeneration' disease.

Project CP/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 Fax: 07 5430 4994 Email: alan.george@dpi.qld.gov.au
Collaborating Institutions	Research Institute of Fruit and Vegetables, Vietnam National Institute of Plant Protection, Vietnam National Agriculture and Forestry Research Institute, Laos Southern Fruit Research Institute, Vietnam Department of Agriculture, Thailand
Project Budget	\$388,981
Project Duration	01/07/2001 to 30/06/2007 (Project extended from 01/07/2004 to 30/06/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

This project extends previous research investigating the development of a sustainable temperate fruit industry in Thailand. Temperate fruit industries in Thailand are in the early stages of development, but high prices are paid for temperate fruits in Thai domestic markets. The production of high-value temperate fruits would raise living standards of hill tribe people and encourage them to use sustainable cropping systems. There is also an export market window into other Asian countries from March to May.

Vietnam already grows many fruit crops and the average revenue from fruit production is two to three times higher than that of rice. It is estimated that many more areas are suitable for temperate fruit production. Laos only grows poor-quality local varieties but has other suitable areas to grow low-chill temperate fruit. The problems for growing temperate fruits in Vietnam and Laos are similar to those that have been identified in Thailand: development of insect pests and diseases during high humidity, lack of knowledge on how to select the best varieties and manage the crops, lack of nurseries, lack of marketing studies or plans.

The project aims to establish and develop sustainable low-chill temperate fruit industries (stone, pomegranate fruit and persimmon) in Thailand, Laos and Vietnam through the identification of appropriate sites and varieties and through the implementation of best management practices at the farm level.

Project progress

Year 4 (01/07/2004-30/06/2005)

Laos

With temperate fruits, nectarine was the preferred fruit for marketing in Lao PDR in contrast to Thailand where peach is preferred. Prices received for the newly introduced varieties (about A\$1.50 per kg) are quite high compared with local selections.

Field sites Trees exhibit signs of poor shoot extension growth due to a combination of drought and over cropping. Farmers are still reluctant to heavily thin trees to get adequate size. The concept of thinning is foreign to Lao farmers as they see it as wasteful. Unfortunately, excessive crop loads can lead to a decline in tree health and eventually death. A new field site was selected on the Plain of Jars on a commercial property with excellent soil structure and good drainage. The Plain of Jars region has suitable topography, soil types and water availability for large scale horticultural production. About 200 trees of seven, introduced varieties of peach, plum, nectarine and persimmon were planted.

A new block of about 160 stonefruit and persimmon trees was established at the Kang pho Research Station. The soil type at this site is less suitable for horticultural production because of its clay texture. Trees will need to be heavily mulched to encourage surface feeding.

Establishment of fruit nursery A small nursery has been set up at the PAFO Horticultural sub research Centre near Ponsavan. Following inspection of the new nursery recommendations were made for methods to improve the facility. Project personnel also demonstrated how to germinate 6000 peach rootstock seed, which were introduced as part of the project, and how to prepare a well drained potting mix.

Training The training in Lao PDR was ably assisted by the two Thai DOA experts, one of who will visit Lao PDR again later in the project to assist the regional extension officers in training and managing the peach demonstration sites.

Thailand

Project extension An extension methodologies workshop was conducted at the Royal Project Office in Chiang Mai. The workshop was attended by farmers and extension staff from DOAE, Highland Project and Royal Project Foundation. A better understanding of the constraints to expanding temperate fruit production in Thailand was developed. Further meetings are planned to better co-ordinate extension activities across agencies.

Four farmer sites have been established near Khun Wang research stations with between 150 to 250 trees planted on each site. The oldest trees, at one site, are now 3 to 4 years and producing good quality fruit. Tree age at the other sites ranges from 2 year-old to recently-planted. The main variety being tested is the peach cultivar Tropic Beauty. To increase returns most of the farmers have interplanted this with cash crops including flowers, coffee, or vegetables.

About 100 Tropic Beauty peach trees have been established at four farmer sites in Ang Kang Province, bordering the Myanmar border. These trees are between 1 to 2 years old and should fruit next year.

Linkages with the World Vision project A meeting was held in Chiang rai with the Australian and Thai project leaders for the ACIAR—World Vision project. This was followed up with a visit to field sites of stonefruit at Ban Kon Village and neighbouring sites. Overall there had been a significant improvement in the management of the sites. Over 400 trees of newly introduced varieties such as the peach cultivar Tropic Beauty have been successfully established and fruited. Training was conducted for farmers and World Vision extension staff with a Thai DOA research officer undertaking monthly visits to the sites to supervise and further train the World Vision extension officers.

Project CP/2002/115: Diseases of crops in the central provinces of Vietnam: diagnosis, extension and control

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Sydney, Australia
Project Leader	Professor Lester Burgess Phone: 02 93512526 Fax: 02 93516481 Email: l.burgess@agec.usyd.edu.au
Collaborating Institutions	Royal Botanic Gardens, Australia Hanoi Agricultural University, Vietnam Hue University of Agriculture and Forestry, Vietnam Quang Nam Provincial Plant Protection Sub-Department, Vietnam Research Centre for Medicinal Plants, Vietnam Nghe An Provincial Plant Protection Sub-Department, Vietnam Ministry of Agriculture and Rural Development, Vietnam
Project Budget	\$499,931
Project Duration	01/01/2005 to 30/06/2008
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The Central Vietnamese provinces of Quang Nam, Quang Tri, Hue and Nghe An grow a variety of crops, including coffee, pepper, watermelon, sugar, citrus and durian. Yields of these, and other crops, are falling due to disease. Soilborne fungal agents are the main disease carriers and cause. Fungal diseases are particularly difficult to accurately diagnose without laboratory support, however the central provinces lack diagnostic capabilities and laboratories. The agro-climate of the central region is conducive to the spread of fungal diseases, with effective control dependent on diagnosis.

Previous research supported by ACIAR has significantly built diagnostic and laboratory capacity, but at Hanoi. This expertise has not been extended to the provincial level. As a result scientific and farmer control options are limited. With coffee, black pepper, watermelon and pineapple all export crops and the first two of increasing value, there is a need to protect against further yield declines from fungal diseases by enhancing diagnostic capacity. The overall objective is to improve farm incomes in the central provinces of Vietnam by reducing yield loss from fungal diseases. This reduction will be achieved through the development and promotion of appropriate control measures, to:

- develop the capacity at provincial level to diagnose fungal diseases,
- extend information on these diseases through participatory farmer training, and
- develop control measures in collaboration with farmers.

Project progress

Year 1 (01/01/2005 to 31/12/2005)

The first progress report is due early in 2006.

Project CP/2005/035: Survey toolbox for plant pests - A practical manual for surveillance of agricultural crops and forests

Overseas Collaborating Countries	Cambodia, Indonesia, Philippines, Thailand, Vietnam
Commissioned Organisation	Department of Agriculture Fisheries and Forestry, Animal and Plant Health, Australia
Project Leader	Ms Lois Ransom Phone: 02 6271 5118 Fax: 02 6271 5835 Email: lois.ransom@daff.gov.au
Collaborating Institutions	Not applicable
Project Budget	\$100,000
Project Duration	01/01/2004 to 30/11/2005
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Increasing trade liberalisation has brought with it obligations for countries seeking WTO access. One of these is the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). This outlines domestic regulations for handling the presence of contaminants that may be found in traded commodities, including guidelines and international standards. Nowhere does this impact more than in the trade of agricultural commodities, the main export hope of many developing countries. The SPS Agreement requires countries to have well founded quarantine, technical and scientific capacities, areas in which most developing countries are under-resourced. Provision of a survey toolbox for plant pests will help in devising surveillance programs and other protocols to meet the requirements under the SPS Agreement.

Project progress

Year 1 (01/01/2004-31/12/2004)

- The initial table of contents were developed based on available literature.
- The proposal contents were then discussed at a workshop attended by the Reference Group. The Reference Group consisted of scientists from the Philippines, Papua New Guinea, Vietnam, Indonesia, Thailand, Fiji, Malaysia and across Australia. Observers from ACIAR and the co-funding body RIRDC also attended. The workshop was highly successful with relevant presentations and useful feedback and suggested improvements given. For example, it was agreed that the use of case studies were of great interest. Attendees identified relevant categories of surveys that would be most widely relevant and them volunteered to write the studies. Ideas about how the guideline structure and detailed entries might be improved were provided by all.
- Following the workshop, the ideas have been collated and worked in to a restructured table of contents which was sent electronically to the Reference Group for comments.

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

Overseas Collaborating Countries	Indonesia, Vietnam
Commissioned Organisation	Queensland University of Technology, Australia
Project Leader	Dr Peter Mather Phone: 07 3864 1737 Fax: 07 3864 1535 Email: p.mather@qut.edu.au
Collaborating Institutions	Gondol Research Institute for Mariculture, Indonesia Queensland Department of Primary Industries and Fisheries, Australia Research Institute for Aquaculture No. 3, Vietnam
Project Budget	\$352,374
Project Duration	01/07/2004 to 30/06/2006
ACIAR Research Program Manager	Dr Geoff Allan

Project background and objectives

Global demand for mud crabs has risen over the past decade, led by expanding wealthier markets such as those in Hong Kong, Singapore and elsewhere in Asia. This demand has largely been met by exploitation of wild stocks, causing many to go into decline. Current trends in these fisheries suggest this exploitation is unsustainable. This situation continues to be exacerbated by rising demand for seafood.

Mud crabs (*Scylla* species) are widely distributed across the Indo-Pacific region, mainly in coastal and estuarine areas, making them ideal for fishing. This does also make them highly suitable for aquaculturing, providing some barriers to production can be overcome. Past ACIAR-supported research has developed laboratory-scale technologies for hatching crabs from larvae, a first step in aquaculture development. Large-scale hatchery production is now underway in Vietnam where a leading centre for crab aquaculture has been established, along with others in Indonesia, the Philippines and Australia.

Until diets suitable for crab grow-out can be formulated based on meeting their nutritional needs, further advances will be limited. Most aquaculture of crabs uses 'trash-fish' collected from marine inshore areas or mussel meat from intertidal areas. This can damage these environments and not all feed is likely to be consumed, fouling hatchery ponds. Growing exploitation of trash-fish is also leading to declining numbers, threatening the viability of aquaculture. A cost-effective replacement diet is needed to ensure the benefits gained to date are not lost.

The aims of this project is to:

- evaluate potential for formulated feeds to replace trash fish;
- determine critical nutritional requirements and evaluate key ingredients;
- determine the protein / energy requirements of mud crabs during grow-out phases; and
- formulate and evaluate improved diets.

Experimental diets formulated for use in mud crab aquaculture in the partner countries will be tested for their ability to promote growth under laboratory conditions. If successful, these diets will be used as a basis for developing artificial feeds optimised for mud crab aquaculture. This will require developing diets that are:

- cheaper than the current diets used in intensive or semi-intensive mud crab aquaculture (i.e. prawn feeds in Australia and trash fish in Indonesia and Vietnam);
- able to provide similar or superior production performance to currently available crustacean feeds;

- less likely to impact on water quality than current mud crab diets;
- based on food grade resources which can accommodate the projected growth of the mud crab industry in Australia and the partner countries (PCs);
- made without terrestrial animal protein sources that may transmit diseases such as BSE.

Project progress

Year 1 (01/07/2004-30/06/2005)

In September 2004, project staff travelled to Nha Trang, Vietnam to meet with Vietnamese partners to initiate the project and discuss research priorities and methods. Agreements were reached on the experimental protocols required:

- to establish protein and lipid requirements for juvenile mud crabs during grow out; and
- to assess the digestibilities of local feed ingredients with the potential to replace fishmeal in formulated diets.

During this project staff also travelled to a commercial mud crab hatchery in Hue to observe crablet production of the indigenous species in Vietnam, *Scylla paramamosain*.

Unfortunately, due to DFAT security alerts in Indonesia, it was not possible to visit the Indonesian ACIAR partners in 2004. Regular e-mail correspondence was maintained with the Indonesian Project Leader and growth trials were initiated aimed at determining optimum protein and lipid requirements for juvenile mud crabs (*S. paramamosian*). In May 2005, project staff travelled to GRIM to meet with the Indonesian ACIAR partners. These meetings confirmed excellent progress was being made with the growth studies and that the necessary infrastructure and technical expertise were available to facilitate other nutritional studies outlined in the project.

Progress to Date

Growth trials aimed at determining optimum protein and lipid levels in mud crab diets have been completed at all three ACIAR partner institutions (RIA3 GRIM). Overall, the general trends to emerge from the trials were very similar. Specifically, optimum growth rates and feeding efficiencies were achieved with diets containing between 42% - 47% crude protein and 7 – 12% lipid. There were significant differences in the maximum rates of growth exhibited by crabs at the different institutions. While the basis of these differences is unclear, we suggest that they may arise from variations in the quality of local ingredients used to formulate diets or differences in the average weight of crabs used at the commencement of the trials at each locality.

An unexpected finding to emerge from the mud crab growth trial conducted at Bribie Island Aquaculture Research Centre in Australia, was that high rates of growth could be obtained with the indigenous mud crab species *S. serrata* using a commercial tiger prawn diet. This tiger prawn diet (Turbo; Thailand) promoted rates of growth equal to those achieved with a kuruma prawn diet (Ebistar, Higashimaru; Japan) previously used as the standard mud crab diet during grow out. Moreover, the Turbo tiger prawn diet contains 15% less crude protein than the Ebistar kuruma prawn diet and is 80% lower in price.

Project 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 Fax: 03 5563 3462 Email: sena@deakin.edu.au
Collaborating Institutions	University of Agriculture and Forestry, Vietnam Department of Agriculture & Rural Industries, Fisheries Division of the Provincial Governments of Yen Bai, Vietnam Victorian 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

Vietnam's reservoirs are a source of livelihood for many people living around them, and often these communities include displaced people and ethnic groups who tend to be the poorer sectors of the community. Two types of fishery are involved: culture-based fishery in small, farmer-managed reservoirs and capture fishery in medium and large reservoirs. The average level of production from Vietnam's reservoir fisheries is among the lowest in Asia, suggesting that their potential is not being realised. Thus, fishery research and development is a priority for the Vietnam Government. The current project builds on the recommendations of an initial study, which found that there is potential to develop culture-based fishery in small reservoirs and that rearing fry to fingerling stage in perennial reservoirs could help to meet seed stock requirements.

In Australia, public waters such as areas of the Murray–Darling Basin have the potential to be used for fisheries and aquaculture, but there is little scientific basis and policy or planning framework for such enterprises. The main aim of this project is to increase the availability and affordability of fish to the rural poor and to generate livelihood opportunities for communities living near reservoirs, by providing the Vietnam Government with relevant information and advice on how to significantly improve the fish yield from reservoirs.

Project progress

Year 3 (01/01/2004-31/12/2004)

Farmer-managed reservoirs: The second culture-cycle trial in Thai Nguyen and Yen Bai provinces was completed. The data from this trial and that of the previous cycle have been analysed and consequently recommendations on the stocking density and the best species combination to be used in each of the provinces are now available. It is intended to disseminate these findings through a series of district level workshops in each of the provinces in the course of 2005.

Three Vietnam researchers spent three weeks at Deakin University; during their visit the data obtained in the two culture cycles was analysed and material prepared for a scientific publication as well as for dissemination to farmers.

A national workshop was held: *Culture-based fisheries: a sustainable development strategy for inland rural areas in Vietnam*, bringing together all stakeholders (farmers, Provincial Government Authorities, Researchers and Ministry of Fisheries (planners and senior administrators)). The recommendations and conclusions of the workshop primarily included the following:

- culture-based fisheries is a useful strategy for adoption in rural areas in Northern Vietnam,
- there is a need to popularise this activity through a series of district level workshops and use of suitably prepared technical material,
- the MoF will take steps to include this activity in its future fisheries developmental plans,
- the MoF and Provincial Governmental authorities will take steps to make appropriate legislative changes, such as the rules governing the leasing of water bodies, to facilitate culture-based fisheries development in Northern Vietnam, and
- a study be conducted on the marketing of culture-based fisheries produce, and make suitable recommendations to MoF and Provincial Governmental authorities of establishing marketing channels that would further ensure its sustainability.

Capture fishery in reservoirs: Collection of data on the fishery in 14 large reservoirs has continued in to the second year. Detailed historical data for two reservoirs were also obtained and these are being analysed. The Geographic Information System analysis of the catchments of the reservoirs, examining land use patterns in particular, has been completed. This information will be utilised in conjunction with fishery data to explore the possibilities of developing yield predictive models, as a management tool, for reservoirs in Vietnam. Fishery data collection was extended to include the shrimp fishery in Thac Ba and Nuicoc reservoirs, and will add an extra dimension to the study.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Kevin Williams Phone: 07 3826 7284 Fax: 07 3826 7222 Email: kevin.williams@csiro.au
Collaborating Institutions	Research Institute for Aquaculture No. 3, Vietnam Queensland Department of Primary Industries and Fisheries, Australia Institute of Oceanography, Vietnam University of Fisheries, Vietnam
Project Budget	\$854,979
Project Duration	01/01/2005 to 30/06/2008
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Marine lobsters attract premium prices, selling for an average of A\$50 per kilogram (Vietnam figures 2001-02), reflecting the high level of demand. Supply, however, has reached its maximum sustainable levels in many fisheries and in some cases has breached these levels. If increasing demand is to be met, it must be sustainably – aquaculture offering the only way of achieving this. In Vietnam the production of cultured lobster is estimated as being worth A\$100m a year. An abundance of lobster seed is the main driving force behind the industry's recent expansion. But mortality rates in rearing lobster from seed remain high. Rearing is based on a diet of fresh fishery by-catch, which is seen as a source of increasing environmental pollution. Both wild collection of seed stock and the trawling and use of bycatch are threatening the industry's long term sustainability, as coastal environments begin to degrade and pressure grows on lobster populations.

The Vietnamese grow-out industry has a low-technology base, predominately using sea cages to fatten the ornate tropical lobster (*Panulirus ornatus*). Improvements in post-capture survival rates when rearing, including through pellet diets that reduce environmental impacts, will substantially boost production, benefiting the industry in Vietnam and Australia. The project is working to enhance the sustainable production of tropical spiny lobster in Vietnam (and indirectly more widely throughout Southeast Asia) and to develop technology that facilitates commercial establishment of tropical spiny lobster grow-out aquaculture in Australia.

Project progress

Year 1 (01/01/2005 to 31/12/2005)

The first progress report is due early in 2006.

Project 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 Fax: 08 9239 8105 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

Aquaculture, or fish farming, is the fastest growing food production sector in the world. It is being seen as a sustainable solution to the growing pressure that increased fishing activities are placing on wild resources. Advances in culturing fish are reducing the capture of wild juvenile fish, to then grow to size, boosting the value of fish farming. But further advances are needed to ensure aquaculture itself remains a viable and sustainable option for smallholders and the environment alike. One component where advances could enhance sustainability is in fish diets. Most fish farmers do not buy commercial feeds. The high cost of these are not adequately returned in the market price of fish. Farmers make their own feeds using available ingredients, such as rice bran and trash fish. Often these formulations do not sufficiently meet the nutritional needs of growing juvenile fish. To compensate some farmers ensure excess food and nutrients are available, eating into profit margins and increasing the likelihood of environmental impacts.

In Vietnam and Cambodia smallholder farmers are keen to get involved in aquaculture. The main barrier is a lack of information on the ingredients for diets. This, when assessed against the nutritional needs of fish species farmed, can help in formulating optimal diets. Differences in feed requirements also extend to the stage of development; high protein and energy required in juvenile fish is not always suitable for maintaining health in fully grown fish. Bio-energetic modelling, using these variables, can define protein and energy requirements and then guide the formulation of diets using local ingredients to match these parameters. The overall aim of the project is to enhance the development of sustainable aquaculture using locally (Vietnam/Cambodia) derived ingredients and better formulated feeds to:

- develop diets based on locally-available ingredients for improved production of (*Pangasius* catfish and tilapia in southern Vietnam, *Pangasius* catfish in northern Vietnam and Cambodia and barramundi in Australia),
- demonstrate/evaluate the potential of new improved feeds in on farm trials, and
- transfer technology and extend information.

Project progress

Year 1 (01/01/2004-31/12/2004)

Develop diets based on locally-available ingredients for improved production of catfish and tilapia
Progress has been made in collecting a range of ingredient samples for a collective ingredient database. Collection of these samples continues to build a critical number to allow analysis of all samples together. Determination of the nutritional value of key ingredients will begin in July 2005.

Nutritional requirements of fish species in Vietnam & Cambodia. Growth data and samples of tilapia and catfish from commercial farms have been collected in both northern and southern Vietnam. Data collected and samples yet to be analysed, will be used in constructing preliminary factorial growth models in June 2005. This review will also allow for data assessment to identify gaps where further samples and/or farm data are required. Maintenance energetics trials on tilapia and catfish have been conducted in northern and southern Vietnam. Sample analysis from these trials is also pending. Only an energy utilisation efficiency trial is required for both tilapia and catfish to enable the initiation of complete energetic models for these species.

Transfer technology and extend information Workshops among the project participants were held in September 2004 and more are planned for 2005. These workshops serve to develop technical capacity in the partner country collaborators and also review existing data-sets collected.

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

Overseas Collaborating Countries	Indonesia, Philippines, Thailand, Vietnam
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Mike Rimmer Phone: 07 4035 0109 Fax: 07 4035 6703 Email: Mike.Rimmer@dpi.qld.gov.au
Collaborating Institutions	Southeast Asian Fisheries Development Centre, Philippines Central Research Institute for Aquaculture, Indonesia Research Institute for Aquaculture No. 1, Vietnam Network of Aquaculture Centres in Asia Pacific, Thailand Sam Ratulangi University, Indonesia Research Institute for Coastal Aquaculture, Indonesia Gondol Research Institute for Mariculture, Indonesia CSIRO Marine and Atmospheric Research, Australia
Project Budget	\$887,710
Project Duration	01/07/2004 to 31/12/2007
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Aquaculture is an important source of supply, particularly of high-value marine finfish. Interest in pursuing this has grown, reflecting both the incomes on offer to smallholders and the potential easing of pressure on wild stocks, both driven by the lucrative (up to US\$70/kg) paid in some parts of Asia.

The sustainability of aquaculture production continues to grow, as research delivers improvements to fish grow-out survival rates. ACIAR-supported research (FIS/1997/073) developed improved diets and rearing strategies for some species. Despite this success some problems remain to be addressed: wild fry and fingerlings being used as a source of seed stock, the poor survival in rearing from larvae and the role of trash fish (low value species usually found as by-catch in fishing for higher-value species).

With marine finfish playing an important role in the economic well-being of many coastal communities, ensuring the sustainability of aquaculture is important to maintaining wild fisheries. Without such production fishing pressure on wild stocks will increase, fisher folk will increasingly be forced to trawl for trash fish and increasing numbers of wild fry and fingerlings will be removed from wild populations to act as a source of seed stock.

The overall objective of the project is to enhance the sustainability of marine finfish aquaculture in the Asia-Pacific region by improving hatchery production technology and facilitating the uptake of compounded feeds for grow-out.

Project progress

Year 1 (01/07/2004-30/06/2005)

Many of the research activities of FIS/2002/077 have been delayed by various changes within the participating agencies. This has necessitated a major revision of the project, and has effectively delayed its implementation by 6–12 months.

Hatchery technology

Preliminary sampling has been carried out to assess the nutritional requirements of grouper larvae, and to identify the causes of the deformities that are commonly seen in hatchery-reared fish in Indonesia.

Grow-out feeds

Evaluation of the use of poultry offal silage meal to replace fishmeal in grouper diets indicated that the inclusion of poultry offal silage meal at rates up to 20% (equivalent to a 37% replacement of fish meal protein) had no significant effect on fish growth, survival or carcass composition of juvenile *E. fuscoguttatus*. Higher levels of replacement may be beneficial but possible deficiencies of methionine, histidine and lysine may have to be overcome through the use of crystalline amino acids or complementary protein sources.

Asia-Pacific Marine Finfish Aquaculture Network

Extension and coordination activities, carried out through the Asia-Pacific Marine Finfish Aquaculture Network (APMFAN), have continued from the earlier grouper aquaculture project (FIS/97/73). Private sector support for APMFAN has been provided by Skretting, who provide support for the electronic publications (eNews and eMagazine) and are sponsoring four participants in the grouper hatchery training course over two years.

The results of FIS/97/73 were published as an ACIAR Monograph (no.110 – *Advances in Grouper Aquaculture*) and around 1,750 hard copies have been distributed and over 196 downloads of the electronic version recorded.

Two practical extension guides were produced:

- A Guide to Small-Scale Marine Finfish Hatchery Technology
- A Practical Guide to Feeds and Feed Management for Cultured Groupers

Around 150 hard copies of each have been distributed, and 1,364 and 870 downloads (respectively) of the electronic versions recorded. These two guides are currently in the process of translation into Indonesian, Thai and Vietnamese for distribution to farmers and investors in Asia.

Twenty-six issues of the APMFAN eNews were produced up to 30 June 2005, and three issues of the APMFAN eMagazine were produced. The distribution list for electronic publications is now around 1,088.

The 3rd Regional Grouper Hatchery Production Training Course was successfully carried out at the Brackishwater Aquaculture Development Centre, Situbondo, East Java, Indonesia from 18 April to 8 May 2005. There were participants from Australia, Brunei Darussalam, Indonesia, Malaysia, Maldives, Marshall Islands, Singapore, and Vietnam. Skretting sponsored a private sector participant from Vietnam as part of that company's support for APMFAN. APMFAN sponsored a fisheries officer from Aceh to participate in the training course as part of the capacity building for rebuilding the aquaculture sector in Aceh.

The first Study Program on Marine Aquaculture and Seafood Markets in Southern China (Guangzhou, Dayawan, Shenzhen, Shanwei, Yau Ping and Hong Kong) was successfully carried out from 4–15 July 2005 as an APMFAN activity. The Study Program was organised by the Network of Aquaculture Centres in Asia-Pacific (NACA), in cooperation with the Guangdong Provincial Bureau of Ocean and Fisheries, Guangdong Fishery Society, Guangdong Dayawan Fishery Development Center (Department of Marine and Aquatic Products, China), the Agriculture, Fisheries and Conservation Department (AFCD) – Hong Kong SAR. The Study Program introduced participants from exporting and producing regions in the Asia-Pacific area to the markets and marine aquaculture in southern China. There were 14 participants from China, Hong Kong, India, Indonesia, Maldives, Marshall Islands, Philippines, and Singapore.

The process of formalising participation in APMFAN is continuing. The Terms of Reference for Regional Resource Experts (RREs) and Regional Resource Centres (RRCs) have been developed (based on those developed for the NACA Aquatic Health Management Program) and an official letter has been sent to member governments.

Project 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 Fax: 07 3864 1535 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 Mekong River Basin is home to fisheries which provide food security for approximately 60 million people spread across several countries. Despite their importance management of these fisheries is rudimentary at best. The Mekong River Commission (MRC), formed under the cooperation of the four countries sharing the lower parts of the basin, have begun to focus on achieving sustainable fisheries management to ensure food security is maintained, while also factoring in growing development pressures on the river. The basin offers a wide range of agricultural and industrial development opportunities. Hydrological power development is one such opportunity that threatens fisheries, while the importance of the river as a trade link between the six riparian countries through which it runs, is also likely to increase. Population increases will continue to put further pressure on the surrounding environment and river system itself, as well as on the capabilities of Mekong fisheries.

Management of these fisheries is complicated by the high level of diversity of fish species. Sustainable management practices can vary between species depending on ecology and life histories. The MRC has initiated extensive studies of the ecology of a number of important fish species to understand ecology and life histories better. The use of genetic methodologies for identifying discrete gene pools has not been used in the Mekong. Elsewhere these techniques are being applied to fish stock discrimination to form the basis of fisheries management plans. The application of these techniques is possible for the Mekong and will be trialled. Project work will determine the pattern of genetic structure of two economically important carp species (*Henicorynchus siamensis* and *H. lobatus*) as models and to develop an appreciation of the conceptual basis, data interpretation and application of molecular population genetic analysis to fisheries management in the MRB.

Project progress

Year 1 (01/01/2004-31/12/2004)

Samples of both study species (*Henicorynchus siamensis* and *H. lobatus*) were collected, some purchased from local fishermen on the river and at the local riverside markets. Pectoral fin clips were taken from both species and stored in 70 per cent ethanol for later analysis. Whole fish were preserved and catalogued for future morphometric analysis.

Fishes previously collected by MRC scientists from the Mekong River at Phnom Penh were sampled, catalogued and preserved with both species also collected from around Tonle Sap Lake. Samples were taken from five sites (Kampong Chhang, Pursat, Battambang, Siem Reap and Kampong Thom) situated on the shores of the lake. Subsequent samples were collected at Stung Treng in northern Cambodia by the MRC.

Using a modification of a salt extraction method, total genomic DNA has been extracted from all samples from Tonle Sap Lake along with 20 individuals each from Stung Treng, Phnom Penh and Chau Doc. Two fragments of DNA from the mitochondrial genome have been investigated for their utility in addressing specific questions regarding the population structure of both species. The first fragment is a 350 bp segment of the Control Region (non-coding) and the second incorporates the entire ATPase 6 and 8 protein coding genes with a total of approximately 950 bp.

Sequence analysis ruled the mtDNA Control Region fragment out for further project work due to it being variable to be useful with reasonable sample sizes (i.e. <100). By optimising running conditions for screening the mtDNA ATPase fragment for variation using Temperature Gradient Gel Electrophoresis (TGGE) this should be useable. At this stage only preliminary results from DNA sequencing of a limited number of samples are available, leading to two initial conclusions. Firstly, low levels of divergence among sampling sites seen thus far indicate that a significant amount of gene flow may occur across the extent of the lower part of the Mekong River (i.e. below the Khone Falls). However it must be stressed that further data is needed to verify this statement as significant haplotype frequency differences may exist over greater spatial distances.

Secondly, the level of genetic divergence between the two species appears to be of a magnitude often associated with that seen among different genera rather than among congeners (an average of approximately 15 per cent divergence is seen among Cyprinidae genera while the divergence between *H. siamensis* and *H. lobatus* is 13 per cent for the ATPase fragment). Therefore it may be assumed that the two species under investigation are likely to display very different biologies (until recently *H. siamensis* and *H. lobatus* were considered the same species). Similar morphologies may reflect convergent evolution rather than common ancestry.

Project FIS/2005/030: Dissemination of findings on the "best practice approach" to culture-based fisheries through a series of workshops in selected developing countries in Asia

Overseas Collaborating Countries	Laos, Thailand, Vietnam
Commissioned Organisation	Network of Aquaculture Centres in Asia Pacific, Thailand
Project Leader	Dr Thuy T. T. Nguyen
Collaborating Institutions	Not applicable
Project Budget	\$48,740
Project Duration	10/01/2005 to 31/12/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The objective of this project is to disseminate and share experiences gained through ACIAR projects relating to culturing fish in inland reservoirs. This will be achieved through a series of workshops with local fish farmers, aquaculture planners and developers in Bangladesh, Laos PDR and Cambodia. ACIAR projects in Sri Lanka and in Vietnam on reservoir-based aquaculture have been successful in bringing out legislative changes that could stimulate growth. These projects have also been responsible for recognition and incorporation of culture-based fisheries in the fisheries development plans. Culture based fisheries are an effective way of increasing fish food supplies to rural areas, at an affordable price, and provide income to rural farmers, thereby contributing to poverty alleviation.

Project progress

Year 1 (10/01/2005 – 10/01/2006)

The first progress report is due in early 2006.

Project 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 Fax: 02 6621 2669 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 31/10/2005 (Project extended from 01/07/2004 to 31/10/2005)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Mangrove forests are a well known feature of coastlines in the tropics and subtropics. They are very important in protecting and stabilising coasts in cyclone-prone areas. They act as a nursery for many fish species of economic importance and a habitat for other fauna. They can also be an important resource for local people, providing them with wood and other products. Mangroves are now heavily exploited in many parts of the world. Wood-gathering and fishpond operations are the main threats. Other pressures are mining and mineral extraction, diversion of freshwater (which damages mangrove roots), the development of coastal areas with associated silt and pollution, the construction of channels and harbours, and the disposal of wastes.

About 80 higher plant species, from several different groups, are considered as mangroves. There is thus considerable variety in mangrove forests. This diversity is generally reduced by exploitation or other damaging pressures. Once damaged or destroyed, it is hard to re-establish mangrove forests. The survival rate of seedlings is naturally low, and this difficulty is compounded by a lack of seed availability to establish re-planting programs. It's also important to know what types of mangroves to plant where. If reforestation of degraded mangrove areas is to be successful and appropriate conservation strategies defined, it will be necessary to improve the collection, storage and transport of mangrove germplasm (the seeds) and to understand better the intricacies of mangrove genetics.

Several developing countries have asked ACIAR to help with the problem of obtaining adequate supplies of desirable germplasm to set up mangrove plantations. These requests were the origins of this project. This project aims to improve our knowledge of the genetic variation existing in selected species of mangroves, and then to produce and disseminate germplasm of high quality varieties. The work is expected to benefit mangrove conservation and reforestation in South and Southeast Asia.

Project progress

Year 6 (01/07/2004-30/06/2005)

A microsatellite library has been established for *Avicennia marina* (Maguire et al. 2000a) in order to be able to characterise the genetic variation that exists within and between populations of this species. The results indicate that microsatellites are abundant in the *Avicennia marina* genome and can be valuable genetic markers for assessing gene flow in mangrove communities.

Microsatellite analysis of the genetic structure of this mangrove has also been undertaken, based on six Australian (Qld, NSW, Vic, SA, WA and NT) populations and on populations from South Africa, United Arab Emirates, India, Japan, Malaysia, Papua New Guinea, New Caledonia and New Zealand. This analysis strongly indicated that there was considerable genetic diversity between the various populations of this species and that gene flow was very limited between them. In addition, many populations have "private alleles" (unique alleles found only in the one population). A comparative study of AFLP (Amplified Fragment Length Polymorphisms) and SSR (Simple Sequence Repeats or

Microsatellites) techniques for analysis of genetic diversity in *Avicennia marina* has shown that either, or a combination of both techniques, is applicable to expanded studies of mangroves (Maguire et al. 2001). SSRs are particularly suitable for population-based investigations. AFLPs are more suitable for monitoring propagation programs and identifying duplicates within collections.

It has been established that the distances germplasm naturally moves through pollen and propagule dispersal is in the order of Laura's main outputs. This has important implications when considering introducing non-local germplasm for maintenance or enhancement of natural genetic diversity in restoration programs. Also established are differences in growth characteristics seen in *Avicennia marina* from different parts of Australia as having a genetic (genotype + genotype/environment interaction) rather than an environmental basis.

A successful protocol for the micropropagation of *Avicennia marina* from both seed-derived explants and field-derived explants was developed. A technique for dissecting and establishing the growing seedling from mangrove seeds in aseptic culture was devised to successfully provide enough plant material for investigative media trials. This method is also successful through all the stages of tissue culture to produce a healthy potted plant. Although it does not involve an increase in numbers, it could provide large numbers of plants for field plantings at specified times such as outside the typhoon season in Vietnam.

Callus can be induced from specimens of anthers and ovaries, propagules and mature leaves of *Avicennia marina*. However, callus inducing specimens are still small in quantity and the callus induced suffered from a slow growth rate.

The natural distribution of *Rhizophora apiculata* has been surveyed in the Gulf, East and South of Thailand. The Queensland Department of Primary Industry now require that to conserve genetic integrity mangrove regeneration sites should only use propagules produced in the same catchment as the regeneration area.

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

Overseas Collaborating Countries	China, Vietnam
Commissioned Organisation	State Forests of New South Wales, Australia
Project Leader	Mr Michael Henson Phone: 02 6650 5703 Fax: 02 6651 5027 Email: michaelhe@sf.nsw.gov.au
Collaborating Institutions	Guangxi Forest Research Institute, China China Eucalypt Research Centre, China Queensland Department of Primary Industries and Fisheries, Australia Hunan Provincial Forestry Department, China Chinese Academy of Forestry, China Forest Science Institute of Vietnam, Vietnam
Project Budget	\$682,613
Project Duration	01/07/2005 to 30/06/2009
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Eucalypts are a potential high-value wood for use in construction joinery and furniture. Poor yields result from growth stresses released upon sawing that cause distortion and splitting in logs, so eucalypts in many developing countries are mainly used for fuelwood, pulp and poles. Research will focus on genetic and silvicultural controls to reduce losses. (Other research is examining sawing methods). Breeding strategies and management regimes will be examined, beginning with an overview of plantation resources. Levels of control offered by genetic and silviculture will be assessed to increase quality and other critical traits. Breeding strategies for key species will be developed and communicated, enhancing capacity building.

Project progress

Year 1 (01/07/2005 to 30/06/2006)

The first progress report is due in 2006.

Project 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 Fax: 07 3365 1699 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 Russell Haines

Project background and objectives

Forest cover in Vietnam declined from 44 per cent in the early 1940s to 24 per cent by 1983. Similar declines have occurred in most other tropical countries, including Australia. In Vietnam, the decrease in the supply of goods and services from forests has had a profound effect on rural communities and the nation as a whole. Supplies of building timbers and fuelwood have declined along with the availability of many non-timber forest products such as herbs and medicinal plants. Erosion has increased, causing siltation of rivers, irrigation canals and dams. There has also been a decline in soil fertility in many areas. Inevitably, forest fragmentation and loss has diminished the country's overall biological diversity. Reforestation is therefore a high priority. The Government is now preparing the Five Million Hectare Reforestation Program (5MHRP), which aims to lift the forest cover of Vietnam back to 43 per cent over 10 years. This reforestation will more likely be carried out by smallholders rather than government agencies.

Much of the previous reforestation effort in Vietnam used exotics such as *Eucalyptus* and *Acacia*, which are fast-growing species that tolerate poorer soils. While these will continue to have an important role, there is also considerable interest in using more indigenous and higher value species. The habitat preferences and silvicultural requirements are known for only a few of these species. This represents a serious impediment to the 5MHRP, because if species are planted at inappropriate sites the reforestation effort may fail. A further difficulty is that many indigenous species are now being planted in *ad hoc* mixed-species plantations. Mixed plantations can offer some significant advantages, but only if the species concerned are complementary. Random assortments are unlikely to provide advantages and are more likely to reduce productivity or even fail. Research is therefore needed to define the attributes of complementary species and to identify those situations where mixtures can be advantageous (or where they should not be used). The project is working to develop silvicultural techniques so that greater use can be made of indigenous and other high-value tropical tree species in reforestation projects in Vietnam and Australia.

Project progress

Year 3 (01/01/2004-31/12/2004)

In 2003 the project commissioned the Information Centre for Agriculture and Rural Development (ICARD), MARD to undertake a survey of rural communities in three provinces in the uplands of northern Vietnam. The survey examined the economic and social circumstances in more than 200 households, the extent of recent tree planting and the perceived impediments to further reforestation by these farmers on their own land. A report was distributed to participants of the project workshop held in Hanoi, September, 2004. Further analysis of the data collected during the survey is currently underway.

A second survey aimed to establish the market for timber being produced by farmers and to identify the species preferred by small rural sawmillers and timber users. The survey covered 90 small scale sawmills scattered over four provinces in north-west Vietnam. This work, part funded by GTZ, found

that a variety of trees are being used including fast growing (*Acacia* and *Eucalyptus*) and home garden species (*Melia azedarach*, *Mangletia conifera* and *Atocarpus heterophyllus*). There was a large difference in log prices with the price of native high-value species (*Erythrophloeum fordii*, *Vatica* spp., *Madhuca pasquieri* and *Fokenia hodginsii*) averaging 1,331,000 VND m³ while those of the fast growing exotic species such as eucalypts were around 506,000 VND m³. The availability of timber of most species declined between over the period 2000 to 2003 and timber prices for most species increased over that same time, especially for the higher-value species.

A survey measured over 90 native tree species grown in plantations at 34 sites across northern Vietnam to determine growth patterns for some of the more widely planted tree species. These plantations include monocultures and mixtures and have varying management histories. The data shows that *Canarium album*, *Castanopsis fissa*, *Castanopsis hystrix*, *Chukrasia tabularis*, *Cinamomum cassia*, *Cinamomum iners*, *Dracontomelum dupereanum*, *Endospermum chinense*, *Erythrophloeum fordii*, *Manglietia glauca*, *Michelia mediocris*, *Peltophorum tonkinensis*, *Quercus* spp. should be considered “best bet” species for planting in Northern Vietnam.

Four experimental trials were established in 2002 and 2003 to assess the performance of high value trees and determine whether these grow best in mixed species plantations or in monocultures. These sites have been maintained and measured regularly since then. The trial at Doan Hung is the most advanced and is about to yield useful data on early growth and interactions of the four species in the mixture.

The project held its second annual workshop in Hanoi in September 2004 with 70 participants and included speakers from government research agencies and universities. Like the first workshop in 2003, it was designed to facilitate information exchange between reforestation researchers and to foster collaborative research with other groups. Four young Australian volunteers from both the Australian Youth Ambassadors Abroad scheme and Australian Volunteers International programs have contributed to the project. All have worked on some aspect of reforestation using high-value tree species.

Project 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 Fax: 03 6226 7942 Email: rod.griffin@ffp.csiro.au
Collaborating Institutions	CSIRO Forestry and Forest Products, Australia Forest Science Institute of Vietnam, Vietnam CSIR Environmentek, South Africa Sylvatech Ltd, Australia University of Adelaide, Australia
Project Budget	\$506,055
Project Duration	01/01/2004 to 30/06/2008
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Several species of Australian Acacias have become commercially important in both tropical and temperate regions. These species have gained widespread acceptance due to their high yields, simple silvicultural regimes, prolific seed production and fast growth rates. These traits, however, also carry a level of risk when introduced into exotic environments, that species will reproduce and spread beyond plantations or planned growth to become invasive weeds. The planting of sterile, but high-yielding varieties would overcome this risk. Some forms of acacias are sterile, offering protection against becoming invasive weeds in exotic environments. The sterility comes from manipulating chromosome numbers (ploidy) in search of improved productivity.

Some forms of polyploid such as triploids formed by mating diploid (2n) and tetraploid (4n) parents, are reproductively sterile which confers possible advantages in tree improvement: more harvestable woody biomass may be produced if energy is not invested in maturing fruits and seeds. When genetic modification technology is developed in the future the availability of sterile genotypes is expected to overcome concern about 'genetic pollution' through uncontrolled outcrossing to non-crop trees. During 2001 Shell International Renewables Ltd. donated tetraploid *Acacia mangium* (Am) plants to the Forest Science Institute of Vietnam and made available associated technical reports to the Australian partners. This offers potential to grow this species as a sterile but high-yielding variety.

The project is developing and assessing the utility of polyploid breeding methods for commercially important Acacia species, to position for production of triploid plants from elite germplasm for operational deployment. This goal will be achieved via activities within six sub-projects, each involving work by partner organisations in two or more countries.

Project progress

Year 1 (01/01/2004 to 31/12/2004)

Seed from 15 elite *A. mangium* trees from Dong Ha Vietnamese seed orchard was supplied by the Research Centre for Forest Tree Improvement (RCFTI) in July 2004. This was the starting material for polyploid induction experiments at the University of Tasmania (UTAS). A further 100g bulk seed from 36 parent trees also from Dong Ha was supplied by CSIRO ATSC. CSIR Environmentek in the Republic of South Africa will have access to improved *A. mearnsii* seed supplied by the Institute for Commercial Forestry Research (ICFR). This has taken considerable negotiation to obtain and at the time of writing has yet to be received.

Optimisation of colchicine induction protocols is taking place at UTAS on seed of *A. mangium* and optimised protocols will be repeated in Republic of South Africa on temperate species. A new approach for *Acacia*, treating germinated seedlings in seedling trays, has been successful in producing tetraploid plants. This technique will be optimised and success benchmarked against traditional seed soaking approaches. A literature study reviewing technical options for producing sterile *Acacia* species has been completed by CSIR Environmentek.

Verification of ploidy status in *Acacia* lines donated by Shell Forestry Ltd has been undertaken by UTAS using flow cytometry and by RCFTI using leaf morphology; stomata size, and flow cytometry. A further 29 lines were forwarded to UTAS as cuttings in September 2004 (nine lines were received both in culture and as cuttings). Multiple ramets of each were rooted by UTAS and the ploidy of every ramet will be assessed using flow cytometry. Results will be examined in conjunction with results from RCFTI to monitor stability and/or reversions to diploids of polyploids and quality control. An easy to use stomatal assay has been established by UTAS and will be assessed for accuracy against flow cytometry results for determining tetraploids. A root squash technique for direct assessment of chromosome numbers in root tips has also been established. A four week training course for staff from RCFTI and CSIR Environmentek was designed by staff of the University of New England (UNE) and UTAS to be undertaken in Australia in August/September 2005.

RCFTI has established three trials in three typical locations: Ba Vi (Ha Tay province), Dong Ha (Quang Tri province) and Bau Bang (Binh Duong province). The design was in consultation with staff of CSIRO. Tetraploid *A. mangium* clones produced by Shell were interplanted with diploid *A. mangium* and diploid *A. auriculiformis*. Results on confirmation of tetraploid status of Shell clones has indicated that, although all Shell clones that were sent to Vietnam were identified as 4N, two-thirds may have reverted to diploid status or have been misidentified as 4N when sent. RCFTI have recognised this and labelled Am clones as 4N or 'not sure' 4N in field trials. Controlled pollinations for production of triploids will only take place on positively identified tetraploids. Phenology assessments are being undertaken by RCFTI to monitor flowering to assist in scheduling of controlled pollinations in addition to understanding the effectiveness of the open pollination production of triploids.

Project LPS/2002/078: Improved beef production in central Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Department of Primary Industries, Victoria, Australia
Project Leader	Dr Peter Doyle Phone: 03 58520503, 03 58520500 Fax: 03 58520599 Email: Peter.Doyle@dpi.vic.gov.au
Collaborating Institutions	Hue University of Agriculture and Forestry, Vietnam Quang Ngai Rural Development Program, Vietnam Department of Agriculture and Rural Development, Vietnam
Project Budget	\$607,474
Project Duration	01/04/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

In Quang Ngai Province and other areas of central Vietnam increasing the incomes of smallholder farmers is an important avenue to development. Smallholders have indicated that cattle rearing and finishing were the most desired income generating activity. There is considerable market potential for selling cattle, but knowledge on cattle feeding systems is limited. ACIAR has supported research in this area which resulted in a workshop, during which both the income potential and value of future research were confirmed.

In 2000 data indicated cattle numbers in Quang Ngai at 224,000. Strong beef prices in the main urban areas and overall increases in national consumption have created a market that will continue to demand more beef. Cattle fattening in Quang Ngai Province has attractive returns to labour costs, but still faces some constraints to wider uptake.

Access to credit is a major constraint, as is farmer knowledge of cattle nutrition, production and health. Feeding options based on on-farm resources and supplemented by off-farm protein sources can reduce existing input costs, partially alleviating credit constraints. The project will not, however, delve into credit access, instead focusing on feeding systems in their entirety. The project will link in with the Quang Ngai Rural Development Program to ensure extension activities are sustained beyond the life of the project.

To improve the profitability of finishing cattle the project is developing year-round feeding strategies utilising on- and off-farm feed resources.

Project progress

Year 1 (01/04/2004-31/03/2005)

Establishing the availability and nutritive characteristics of feeds in lowland areas: Assessing feeds in lowland areas of Quang Ngai was undertaken, to help in designing possible year round feed options.

Develop an inventory of feeds: An inventory of feeds available on and off farm and documentation of how these resources are used has been completed. The inventory was developed from surveys undertaken in two lowland and two highland communes and secondary sources of information including provincial statistics, information from the Quang Ngai Rural Development Program (RUDEP), and other relevant sources. Surveys were undertaken in highland communes to assist RUDEP with their development activities.

There is little data on the nutritive characteristics of feeds in Quang Ngai or other central provinces. A database of nutritive characteristics of feeds has been compiled from accessible information on the nutritive characteristics of forages in central Vietnam, published data from Vietnam, and comparisons have been made with information in the international literature. Where available, the database

contains information on location, season and source of data and any important points on harvesting and storage.

As a first step in documentation of year round feed options, feed calendars have been developed for lowland and highland zones. The approaches to testing combinations of feed are still being explored.

Controlled experiments to optimise use of feed resources for productivity and profitability:

Experiments have commenced in Australia to quantify associative effects between forages and concentrates when fed to lactating cows. The first experiment, examining associative effects in lactating dairy cows fed hay and wheat was conducted in January/February with analytical work still in progress.

While work in this activity has not commenced in Vietnam, the first feeding experiment has been designed based on the feed resource inventory for the lowland area of Quang Ngai, and after discussions with RUDEP and Department of Agriculture and Rural Development staff.

Increasing the knowledge and technical skills of scientists and extension staff: The science staff have submitted conference papers on the work conducted in Vietnam and Australia, have or will be undertaking training in scientific writing and have broadened their knowledge and skills in research processes through on the job training activities.

Project LPS/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 Fax: 07 3362-9429 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

The pig production sector is an important avenue for smallholders to earn additional income. Increasingly smallholders are entering the commercial arena, responding to the demand for lean pig products, a valued source of human dietary protein. The major constrain to increased smallholder involvement in the commercial sector and to the long-term viability of commercial operations is the cost of feed. Traditional feeds are based on grains and protein rich components. Prices are being driven up by the increasing global demand for grains. In Vietnam smallholders utilise a variety of feed stuffs, despite limited knowledge concerning their value. Commercial imperatives, however, require feeds that maximise performance and meat quality.

A past project which delivered improved pig genotypes, also examined dietary feeds. Many hundreds of components are available but their value in terms of maximising performance and meat quality is unknown. The project is assessing the suitability of some locally available protein and energy sources as components of commercial pig diets. Adoption of these outputs is intended to lead to reduced prices of commercial complete and concentrate diets and to reduce reliance upon imported dietary components.

Project progress

Year 1 (01/04/2004-31/03/2005)

Protein is frequently the main constraint for the improvement of pig performance in Southeast Asia with most Asian pig production countries having a high dependence on importation of various protein meals. The long-term viability of such pig industries relies on the future likelihood of these countries accessing cheaper local sources of non-conventional feeds. Rubber seeds (*Hevea brasiliensis*) from the Euphorbiaceae family are a substantial by-product of rubber production that currently have little use in animal feeding despite having a reasonable level of protein content. If the anti-nutritive component of rubber seed could be eliminated or have its impact on pig performance ameliorated then rubber seed meal would have a great potential for feeding pigs either by small holder producers or by inclusion in commercial diets. Vietnam has 420,000 ha of rubber trees with density of 500 tree/ha. Based on an estimated production of approximately 300 kg rubber seed /ha, it is then possible to collect nearly 130,000 metric tons rubber seed equivalent to 65,000 metric tons of rubber seed meal without hulls every year from this level of rubber production.

Feed Content: Currently, Vietnamese project staff are collecting samples of feedstuffs for batch analyses. An understanding of the initial level of toxins such as cyanide and gossypol present in the rubber seed and the changes that would occur in those levels as a result of time, handling and processing of the rubber seed is needed. This will enable the development of protocols for the elimination of the toxins present or provide data to assess their risks whilst maintaining maximum nutritive value of the feedstuff.

Feed Treatments: A detailed literature review has been completed to provide essential preliminary information on anti-nutrients and their stability. The literature has shown that the source of the rubber seed will impact significantly on the toxins present and on the composition of the rubber seed. This suggests that variety or agronomy are important both for the nutritive animal feeding value of the meal and also for the use of the rubber seed oil in other industrial applications. This would impact on the economics of any industrial rubber seed processing. Particularly as high value oil would better facilitate investment in large-scale plants to process the rubber seed. Thus the chemical results of the samples being collected will provide data on the feeding values of meal produced and the best use option for Vietnamese rubber seed oil.

In vivo digestibility: Experimental protocol and animal ethics approval have been obtained for studies to be conducted in Australia and these will commence soon with supervision and training of Vietnamese project staff in Australia

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

Overseas Collaborating Countries	Thailand, Vietnam
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Mike McLaughlin Phone: 08 8303 8433, Mob: 0409 693 906 Int: +61 409 693 906 Fax: 08 8303 8565 Email: Mike.McLaughlin@csiro.au
Collaborating Institutions	Department of Agriculture, Thailand Asian Vegetable Research and Development Center, Taiwan Nong Lam University, 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 31/03/2006 (Project extended from 01/07/2005 to 31/03/2006)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

This project developed out of a growing concern about the contamination of agricultural soils and crops in Southeast Asia and because international importers of produce are using the presence of contaminants as a means to restrict trade from these regions. A preliminary investigation — which examined soil and crop contamination in Malaysia and Thailand — found high concentrations of zinc and copper in vegetables and soils. Results also indicated: that many farmers and agricultural industries are unaware of the contaminants that are present in agricultural inputs such as fertilisers, manures, composts and pesticides; that agricultural inputs generated from municipal wastes, industrial sources and soil replacement materials are used as cheap sources of nutrients on farms; and that the intensive use of fertilisers and wastes in peri-urban agriculture leads to the accumulation of cadmium in certain crops.

Because most of the scientific understanding of the behaviour of contaminants that are present in the soil and food chain stems from research in temperate climates in developed countries, health and environmental authorities in Southeast Asia need data on which to base guidelines for contaminants in soils and crops. This project aims to provide a scientific basis for the protection of Australian and Asian soils from irreversible degradation by heavy metals and metalloids. It aims to assess the adverse impact that agricultural and industrial practices have on the soil and the crop quality in tropical regions of Southeast Asia and aims to develop strategies to limit these adverse impacts on agricultural systems and on human health. It also aims to maximise the benefits and minimise the risks associated with the use of wastes and fertilisers in peri-urban agricultural systems.

Project progress

Year 4 (01/07/2004-30/06/2005)

The data generated by the nationwide survey of heavy metals in crops and soils in Vietnam and Thailand have now been used to generate heavy metal contaminant maps for both countries. These have identified a number of regions that have higher than usual and lower than usual concentrations of some of the metals. The reasons for these will be investigated.

Field experiments examining crop uptake and toxicity of animal manures, bio-solids and heavy metals have been completed at all eight sites involved in the study and the subsequent soil analyses are being undertaken. Vietnamese soils and crops appear to be quite sensitive to small inputs of heavy metals, with threshold toxicity values being lower than those found in other countries. It is not clear

whether this difference is due to the Vietnamese and Thai crops being more sensitive than Australian crops or whether it is the Vietnamese and Thai soils that are more sensitive than the Australian soils. This will be resolved by a series of toxicity tests being conducted in Australia using wheat. These will be conducted in the project's extension.

The progress and success of the project was independently reviewed in November 2004 in Ho Chi Minh City. During the review the ACIAR representative and the reviewers visited field sites, laboratories and listened to approximately one and a half days of presentations on the results of the project.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	University of Sydney, Faculty of Agriculture, Australia
Project Leader	Professor Ivan Kennedy Phone: 02 93513546, mob: 0407 949 622 Fax: 02 93515108 Email: i.kennedy@acss.usyd.edu.au
Collaborating Institutions	CRC for Sustainable Rice Production, Australia Hanoi University of Science, Vietnam Institute of Agricultural Sciences of South Vietnam, Vietnam Can Tho University, Vietnam Vietnam Agricultural Science Institute, Vietnam
Project Budget	\$439,620
Project Duration	01/07/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Plant growth promoting rhizobacteria (PGPR) can exist naturally in soils and can be introduced through a process of inoculation. PGPR can improve plant growth and maximise grain yields, particularly where interactions with a group of cooperative factors including stimulated root growth, biological nitrogen fixation, mobilisation of soil N and P, facilitated uptake of nutrients and biocontrol of pathogens are optimised. ACIAR-supported research introduced the concept of biofertiliser technology, through PGPR to parts of Vietnam. A key outcome of this concluded project was to prove the validity of using biofertilisers, both to researchers and particularly to farmers, who reported yield boosts in rice of between 10 and 20 per cent. In addition biofertilisers reduced input costs through lower use of urea. Despite this success the underlying mechanism responsible for the PGPR effect is not well understood.

Without this understanding expanding use of the BioGro biofertiliser beyond the original group of farmers in Vietnam's north is likely to prove difficult. The microbial composition of BioGro contained three different microbes, but in the future actual species used for this biofertiliser may vary. This could result in less than consistent responses and also make quality control based on a more thorough understanding difficult. As the BioGro is tested beyond the north of Vietnam it is possible that different interactions may result in yield variations, a process that is dependent on the PGPR mechanism. This project is establishing inoculant biofertilisers for rice as a reliable technology and to foster extension of its application by studying its economic, social, and environmental benefits.

Project progress

Year 1 (01/07/2004-30/06/2005)

Earlier research findings that statistically significant improvements in the yield of rice could be obtained by inoculation with selected strains of biofertiliser microbes have now been confirmed. In a trial set up at Dai Mo near Hanoi by Hanoi University of Science, treatments with certain combinations of inoculated strains of bacteria and a soil yeast have yielded significantly greater dry rice (dry weight) than other combinations, or compared to no treatment with microbes at all. The variation observed in rice yield of about 1t/ha, depending on the strain of combinations used, has confirmed the important role that many microbes play in the rice plant's rhizosphere and improved crop production.

Other trials based at the Vietnam Agricultural Science Institute and in Nam Dinh province in the Gao Hai district have confirmed the biofertiliser response, giving yields either the same or with some improvement. At the reduced 50 per cent rate of fertiliser inputs, the same or improved yields were generally obtained.

The Institute of Agricultural Sciences of Southern Vietnam supervised another large field trial at Cu Chi near Ho Chi Minh City, designed to examine the interaction between N-levels and biofertiliser response. No statistically significant effect of inoculation with the particular combination of biofertiliser strains used was obtained. There was a consistent trend of increased yield with BioGro at all sites with nitrogen levels used, indicating beneficial effects of inoculation. The trial at VASI suggests there may be a significant interaction between rice cultivar and biofertiliser response, with some rice cultivars responding more than others. There are several other differences in methods of rice production between the north and the south of Vietnam that could also have affected in the result needing investigation.

In June 2005, a BioGro industry workshop was held at the Hanoi University of Science, to study economic and extension aspects of biofertiliser production and use. The workshop included travel by project team members (from all Vietnamese sites including Cantho University) to Phu Ninh in Phu To Province to inspect the Bai Bang Paper Company BioGro production system. The visit involved inspection of field sites where maize and rice were grown with BioGro, and a hilly site where eucalypt seedlings were being raised using BioGro at rate of 400 kg per ha.

Improved efficiency in the use of plant nutrients by rice observed is considered to be a result of better root growth and improved mobility of key nutrients caused by the microbes. The effect is symbiotic in that the microbes depend on carbon compounds excreted by the plant roots for their growth while the plant benefits from the improved nutrient supply provided in return by the microbes.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Department of Natural Resources and Mines, Queensland, Australia
Project Leader	Dr Philip Moody Phone: 07 3896 9494 Fax: 07 3896 9623 Email: Phil.Moody@nrm.qld.gov.au
Collaborating Institutions	Institute of Agricultural Sciences of South Vietnam, Vietnam National Institute for Soils and Fertilisers, Vietnam World Vision of Vietnam, Vietnam
Project Budget	\$395,993
Project Duration	01/01/2004 to 31/12/2006
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Traditional subsistence agricultural systems based on slash and burn practices have degraded soils in upland areas of Vietnam's central highlands. Extensive deforestation and land clearing have resulted, leading to erosion and soil fertility declines. Ethnic minorities who have practiced this style of agriculture have high levels of poverty, and little knowledge of other agricultural practices. The Vietnamese Government has encouraged these minorities to settle in villages and undertake permanent agricultural production in surrounding areas. Soil productivity in these areas remains low, with knowledge of practices to ensure long-term sustainability negligible. Constraints to productivity are numerous and include deficiencies in soils, compaction of soils and the presence of toxic chemical elements in soils.

A variety of soil information has been collected, mainly for soil classification purposes. Despite this information being available little has been made of the data in terms of assessing soil productivity constraints. A simple Soil Capability Classification (SCC) that uses measures and properties (texture, colour, etc) of collected soil to identify constraints and indicates appropriate management strategies exists. Scaling this up for interpretation of soil constraints and management strategies to ameliorate or managing these at the village level is needed to help develop improved practices. The project is providing a decision support framework that allows basic soil information to be interpreted in terms of soil constraints to productivity and to be synthesised into management strategies appropriate for maintaining the long term productivity of upland soils. This will enable results obtained in a site specific context to be applied at the provincial/catchment scale through the use of existing geo-coded soil survey data and the SCC.

Project progress

Year 1 (01/01/2004-31/12/2004)

Two sites have been selected in Gia Lai Province for detailed assessment of management strategies for overcoming soil constraints to productivity. The Ferralsol site is at Ia Kha village, near Pleiku, while the Acrisol site is at An Thanh village in Dak Po District. Initial soil samples to 30cm have been taken from each block of the proposed trials. These samples will be analysed for pH, EC and fertility status to allow selection of appropriate treatments. The constraints of both sites have been assessed using Soil Constraints and Management Package (SCAMP) and are: Ferralsol: P fixation, N and P deficiency, Acrisol: N deficiency, compaction, low infiltration rate and waterlogging. Other factors suspected but to be confirmed are; Al toxicity, low K reserves, low organic C, low ECEC, P deficiency and hard-setting.

A sampling protocol was sorted out for the proposed Ferralsol and Acrisol surveys. Ferralsols on different parent materials will be sampled in three areas of differing elevation and rainfall in Gia Lai Province. Soil properties will be characterised and SCAMP used to define constraints, allowing assessment of the variability required in management practices across Ferralsols. A similar

assessment will be made of variation in the management of Acrisols of An Thanh village, Dak Po District, using recent NISF soil survey data.

The proposed monitoring sites of the World Vision-ACIAR project were visited and their constraints assessed using SCAMP. Based on this assessment, decisions are being made by the project team on appropriate treatments (one of the treatments will be 'farmer practice') at each site.

Further soil properties (soil structure, soil consistence, hard setting tendency, low soil organic C, permeability class, drainage class) have been added to SCAMP to increase its comprehensiveness. To facilitate the adoption of SCAMP, it is proposed that three application 'levels' will be developed:

- level 1 based on field observations only,
- level 2 based on field observations and field measurements, and
- level 3 incorporating Level 2 measurements plus lab measurements.

A manual describing the levels is in preparation.

Queries have been made of an Access database containing SCAMP categories for several soil constraints and geo-coded soil survey data for the Herbert catchment (north Queensland), and a series of risk and constraint maps have been produced. These maps have validated the queries and data sorting protocols that have been developed in this project to link geo-coded data and SCAMP attributes.

Project 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 38969433 Fax: 07 38969446 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 \$747,602
Project Budget	
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

Australia (about 25-30 million tonnes), China (495 million tonnes) and Vietnam (30 million tonnes) produce significant grain harvests each year, including rice, wheat, maize and other grains. Each country fumigates about 80 per cent of this grain with phosphine. Due to the combined advantages of low cost, ease of use and acceptance as a residue-free treatment, this fumigant will remain the central component of insect pest management for the foreseeable future in Australia and throughout Asia. However, scientists in an earlier ACIAR project identified that resistance in target pests threatens the continued viability of this fumigant. It also became apparent that several other factors, in addition to resistance, were contributing to control failures with phosphine.

To ensure the continued viability of phosphine technical innovations to enhance the efficacy of phosphine and the development of management strategies to control several psocid species are needed. These have developed as a major problem in stored grain in China. Psocids have also emerged as a major problem in Australia, and initial work here has shown that resistance to phosphine is an important factor, but ecological aspects may also be important.

This project will formulate and verify national fumigation standards for China, Vietnam and Australia, improve fumigation practice in China and Vietnam by undertaking training programs, investigate potential innovations to enhance the efficacy of phosphine fumigation, and determine the key factors preventing effective control of psocids with phosphine. This will protect and enhance the utility of phosphine as a fumigant for grain and to more fully integrate it into pest management in grain storage systems.

Project progress

Year 4 (01/01/2004-31/12/2004)

Formulate and verify national fumigation standards (develop and submit for approval phosphine fumigation standards for Vietnam): Effective disinfection systems for grains are essential for Vietnam to access international markets, to maintain commodity quality, retain quarantine integrity and assure food security. However, resistance in target insect pests, out of date fumigation standards, and poor fumigation practice have contributed to many control failures costing millions of dollars in remedial treatments and physical losses.

Fumigation standards: Results of surveys undertaken by officers of the Plant Protection Department reveal that, although not common, strong resistance to phosphine is present in some species.

Resistance was further characterised using specialised flow-through equipment and times to population extinction established for strongest resistant strains. Field trials have also been undertaken in rice storages, all of which will form the basis for updating Vietnam's phosphine fumigation standard.

Resistance to phosphine in Liposcelis spp.: Psocids (*Liposcelis* spp.) have become major pests of many stored durable commodities in Vietnam. These insects proliferate rapidly and have become a threat to Vietnam's export trade and domestic storage system. Officers at the Plant Protection Department, Hanoi, have undertaken a survey of psocid populations in central storages belonging to the Department of National Reserve. They found that *L. entomophila* and *L. bostrychophila* are the major pest species. These strains are currently being tested for resistance to phosphine. Results to date reveal that resistance is present in all strains of *L. bostrychophila* while none of the strains of *L. entomophila* tested showed resistance. One strain of *L. bostrychophila* showed a level of resistance stronger than that seen in the most resistant strains of other pest (e.g. beetle) species.

Training needs: Discussions have taken place with the Dept of National Reserve to identify training needs and a training plan is being developed in cooperation with the Plant Protection Department.

Decrease losses to stored food suffered by farmers by researching and extending improved household storage techniques: Maize is the staple food of people living in mountainous regions of northern Vietnam. A major problem for them is the loss of 20-40 per cent of production after harvest due to mould and insect contamination. Officers of Vietnamese Institute for Agricultural Engineering and Post Harvest Technology (VIAEPHT) successfully developed a horizontal dryer for batches of 500-1000 kg maize. These machines will dry the grain from 22 per cent moisture content to <14 per cent in 6-7 hours resulting in significantly reduced mould, mycotoxin and insect contamination. Trial results showed that grain could then be stored successfully for 4-5 months. Such equipment is unaffordable for many mountain farmers but units are being acquired by farmers in the more prosperous coastal districts.

In mountainous regions, corn is commonly stored on the cob in lofts of village households. This practice was previously adequate for storage of traditional low-yielding maize varieties. However, since the introduction of high-yielding hybrids, losses suffered in storage using this method are typically about 20 per cent. VIAEPHT showed that a mobile stove can be used to effectively dry the corn in 10-12 days. This innovation is affordable and compatible with village life and results in lower and more uniform moisture content and a reduction in losses to about 5 per cent. VIAEPHT officers also developed double cover bags that will store corncobs, once dried, in good condition for up to 6 months.

The VIAEPHT project team delivered 4 training courses, each for about 70 farmers, in the mountainous provinces of Nghe An and Thai Nguyen. Topics covered: insect pest detection and damage, results of field trials, use of practical, effective cleaning, drying and storage methods. Officers of VIAEPHT have also produced a practical IPM manual for farmers.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	NSW Department of Primary Industries, Australia
Project Leader	Dr Shane Hetherington Phone: 02 63913860 Fax: 02 6391 3899 Email: shane.hetherington@agric.nsw.gov.au
Collaborating Institutions	National Institute of Plant Protection, Vietnam Research Institute of Fruit and Vegetables, Vietnam Queensland Department of Primary Industries and Fisheries, Australia Department of Agriculture and Rural Development, Vietnam
Project Budget	\$766,082
Project Duration	01/07/2004 to 31/12/2007
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Quality temperate fruit such as peaches, apricots, plums and persimmons have been introduced into the cooler upland regions of north-western Vietnam. Ten mountain provinces now grow temperate fruits, their climates having a suitable temperature range to accommodate cool climate fruit trees. The exotic nature of these cool climate fruits in a tropical climate attracts a price premium, but poor quality caused by pre and postharvest losses is limiting this potential. ACIAR has supported research to improve crop management and to reduce the impacts of fruit fly pests, two main factors in reduced quality. The Vietnamese Government is supporting infrastructure development, however significant losses of fruit continue. Between 30 and 40 per cent of fruit does not reach market. A substantial amount of fruit is also harvested before ripening to avoid disease and pest losses, but this ensures low quality. Poor transportation processes exacerbate the potential for disease outbreaks postharvest and also result in damaged fruit.

Changes in pre and postharvest management can significantly impact on fruit quality and lifespan. Harvesting at the right time will improve quality with fruit fly management strategies likely to reduce the need for harvesting before ripening. The introduction of new cultivars can further limit losses and help create an economically viable industry for poor farmers. The project is determining postharvest disease and quality management problems associated with the production and distribution of temperate fruits to establish regionally feasible changes to production and postharvest systems that will improve fruit quality and reduce postharvest losses in Vietnam and Australia. Project activities will also improve research and development capacity and extend project results through training activities and farmer linkages.

Project progress

Year 1 (01/07/2004 to 30/06/2005)

Understanding the market: Before innovations introduced through this project can be implemented, the current fruit production system must be understood. Surveys conducted this year highlighted key regional differences in distribution chains, handling and target markets. Economic data was also gathered so that the impact of innovations can be better understood as the project progresses.

Making orchards work better: Vietnamese fruit compares poorly with its imported market-place competition. It is small, immature and often damaged or diseased. Many of these problems have their origins in relatively poor orchard management. During the 2005 Vietnamese fruit season (April – July 2005), seven orchards were selected across three fruit-growing districts; Sa Pa and Bac Ha (Lao Cai Province) and Moc Chau (Son La Province). These orchards contained French peach and Tam Hoa plum trees. Experiments have been set up to examine how improved management can produce improved fruit. These orchards will serve as demonstration plots later in the project.

Harvest indices: In the past fruit in northern Vietnam, has been harvested green-hard to avoid fruit fly infestation and better withstand the rigours of harvest, handling and transport. Fruit fly control through bait-sprays is now available. Research has begun to determine a harvest maturity which will deliver fruit to consumers when it is most appealing. A trial was conducted during the 2005 fruit season and examined fruit attributes such as blush, taste and aroma of fruit harvested at various maturities. This will lead to a harvest timing recommendation.

Disease management: Diseases such as brown rot and Botrytis rot cause significant losses to the Vietnamese fruit industries. During the first year of this project a system to control diseases using cultural techniques and locally available fungicides was developed and will be tested over coming seasons. Dipping fruit in the fungicides carbendazim and iprodione after harvest was shown to decrease postharvest disease occurrence by 25 to 50 per cent. Other experiments being conducted in Vietnam and Australia are beginning to investigate the use of non-fungicide options such as biological control and aromatic oils for controlling diseases.

Improving packaging: In order to get sufficient chill to produce fruit the Vietnamese temperate fruit industry is based in the mountainous north-west provinces. The distance between the production regions in this project and their markets varies between 3 (Moc Chau to Hanoi) and 72 hours (Bac ha to Ho Chi Minh City). Research has shown that during transport of Tam Hoa plums from Bac ha to Hanoi fruit core temperatures can approach 32°C. Fruit is also subject to compression and bruising because of inadequate packaging. Losses of fruit are high. Impact during transport is damaging fruit. Plans are being developed to trial a number of packaging materials during the 2006 fruit season. These materials will need to be *locally* available and relatively inexpensive.

Ethylene inhibition, quality maintenance and improved storage life: Aminoethoxyvinylglycine (AVG) is a naturally occurring fermentation product that inhibits ethylene production. Preharvest application of AVG has been shown to have a number of benefits including delaying harvest, improving firmness, increasing soluble solids and extending storage life. The level of benefit derived from AVG application depends on variety, fruit maturity and storage conditions. A trial was conducted in 2005 to determine if application of AVG before harvest could lead to quality benefits postharvest. Specifically, AVG has been shown to improve fruit firmness which would be of benefit in Vietnam given current transport systems. Rain during this trial resulted in fruit being harvested earlier than desired. AVG provided no benefit under these conditions. The trial will be repeated next year.

Project PLIA/2000/165: Facilitating farmer uptake of ACIAR project results: World Vision collaborative program

Overseas Collaborating Countries	Laos, Thailand, Vietnam
Commissioned Organisation	World Vision Australia, Australia
Project Leader	Mr Jonathon Treagust Phone: 03-9287 2509 Fax: 03 92872377 Email: jonathan.treagust@worldvision.com.au
Collaborating Institutions	World Vision of Vietnam, Vietnam Laos World Vision Foundation, Laos World Vision Foundation of Thailand, Thailand Queensland Department of Primary Industries and Fisheries, Australia
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

Increasing the impact of ACIAR project results has been furthered through a partnership with World Vision (WV) projects where provision of technologies arising from ACIAR projects can further agricultural productivity. 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 Southeast Asia under this MoU. This project consists of a set of six collaborative sub-projects between ACIAR and WV in Laos, Thailand and Vietnam. Results arising from a mature or completed ACIAR project activity which are suitable for farmer-level extension are integrated into an active WV project in particular provinces the three countries.

In Thailand three subprojects are addressing agricultural productivity and impacts; firstly the use of chemicals in vegetable production and specifically preventing chemical runoff and pollution. A second sub-project is improving fish feeds for aquaculture using locally available ingredients. Finally the third sub-project is introducing improvements applicable to growing low-chill temperate stone fruits. The single Laos sub-project is seeking to introduce improved crop options by boosting wet season rice production and utilising other crops in the dry season. Two 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.

Project progress

Year 4 (01/01/2004-31/12/2004)

Assist farmers in Bac Binh district to protect rice crops from rodent damage, by using environmentally benign methods: The project, now in a short extension phase, is developing a user-friendly, field-based toolkit for extensionists and farmers to effectively establish and maintain the use of the Capture Trap Barrier System (CTBS).

This system utilises a lure crop, planted before the main crops, to attract rodents. The lure crop is surrounded by plastic barriers with one-way entries leading to traps. Rodents are trapped in sufficient numbers to affect the population dynamics, limiting their impact on the following rice crop. Rodent population cycles coincide with the availability of feed options, so that as crops mature breeding cycles are completed, ensuring food for young rodents.

In addition, this extension is expanding the implementation of the CTBS in Bac Binh from three communes (Phan Ri Thanh, Lu Son, S Luy) to six communes (Hai Ninh, Phan Thanh and S Binh).

Four additional districts within Binh Thuan province (Tuy Phong, Ham Thuan Bac, Duc Linh, Tanh Linh) are also being targeted. The implementation of the CTBS will also be expanded to other World Vision Area Development Programs (ADPs) in other districts in Vietnam.

Soil management: An extension to the project is expanding the culture of farmer learning in Bac Binh. Knowledge on soil management gained during the first phase of the project (2001 to 2004) is being consolidated and packaged into extension material. Through this the capacity of district and commune partners to further apply their new-found knowledge of soil management has been enhanced.

An expanded number of local farmers have been engaged through these processes to use the recommended soil management techniques. A pilot test of appropriate water management technology is also underway.

The extension is coordinating closely with the work being done, mostly in Gia Lai province, on soil capability classification through a Land and Water Resources project on soil data for sustainable management of upland soils. Any appropriate, field-based tools developed as a part of the soil capability classification will support the suite of soil management techniques available to farmers in Bac Binh.

As a result of these activities the project is helping farmers in Bac Binh District, especially those who live in remote areas of the district, to access research from completed ACIAR projects in the area of soil fertility. Helping farmers understand and be able to identify soil type and assess the current nutrient status of the soil and identify ways to improve current soil fertility management is maintaining and, in some areas, increasing crop yield. Farmers are also being exposed to methods to improve soil quality in untapped and less-favoured land areas. This is Improve food security at the household level.

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

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	Department of Primary Industries, Victoria, Catchment and Agriculture Services, Australia
Project Leader	Ms Rosemary McKenzie Phone: 03 9658 4744 Email: rosemary.mckenzie@dpi.vic.gov.au
Collaborating Institutions	Ministry of Agriculture and Rural Development, Department of Science and Technology, Vietnam
Project Budget	\$399,353
Project Duration	01/07/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Jeff Davis

Project background and objectives

The Vietnamese Government are increasingly directing budgetary resources to agricultural research and development. As a result there has been a corresponding community increase for accountability and expectations of seeing real outcomes from R&D. What is lacking is a strong evaluation framework to demonstrate and help deliver outcomes. Strengthening both the role and frameworks for evaluation will address this problem. The ability to evaluate a range of R&D projects and their outcomes, including such grey areas as scientific capacity and capability begins with project planning. Many Vietnamese organisations have little experience in organisational learning and supporting evaluation systems. As a result planning to ensure efficient and effective R&D outcomes is often limited or absent. This is particularly the case with 'fuzzy' or poorly defined concepts and projects. This creates a disconnect between project outcomes and meeting public demand to show outcomes and link them to projects.

In Australia the Department of Primary Industries, Victoria (DPIV) has addressed a similar set of issues, driven by State Government policy priorities. Part of this approach has focused on evaluation tools for emerging impacts of R&D and how these can be applied to guide projects to better outcomes. Mapping outcomes of science capability and capacity has also been addressed through a story approach utilizing performance indicators and concept mapping. The DPIV approach will be trialled and tested for its applicability to the Vietnamese context, at the Ministry of Agriculture and Rural Development.

The project is enhancing the impact of agricultural research by MARD and DPIV by developing an evaluation procedure for research and development projects suited to the MARD environment, and by developing a procedure for evaluating science capability (initially for DPIV, later for MARD)

Project progress

Year 1 (01/07/2004-30/06/2005)

A number of key activities have been successfully undertaken including:

- training of MARD evaluation officers in Australia during an eight day orientation and in Vietnam during an intensive training and mentoring program provided by the DPI Evaluation training manager
- selection of two case study research projects in national Science Institutes in Vietnam to trial evaluation approaches and tools. A post-harvest fruit preparation project and a hybrid rice-breeding project have been selected. Needs assessment and project clarification have been completed, theories of action developed and draft evaluation plans prepared by MARD evaluation officers which are currently being reviewed by DPI evaluation personnel.
- production of draft evaluation guidelines for MARD that has involved identification of MARD needs, based on consultation with senior MARD personnel. The draft guidelines will be reviewed in Australia and confirmed by MARD personnel prior to their formal adoption by

MARD in September 2005. MARD is seeking a shift from an outputs focused, monitoring form of evaluation to a system that can assist in identifying impact and outcomes and contribute to policy development and investment decisions.

This phase of the project has been enhanced considerably by the leadership provided by an Australian Youth Ambassador with evaluation experience to MARD. The Youth Ambassador has provided vital mentoring to the MARD evaluation officers and has been a driving force in developing methodological approaches that are responsive to the evaluation needs of MARD. It is apparent that MARD evaluation officers are rapidly developing skills and confidence in applying appropriate evaluation approaches to the selected case studies.

An innovative methodology termed concept mapping has been used to define DPI's understanding of the concept of science capability, involving scientists, management and industry stakeholders. Concept mapping is a structured brainstorming process used by groups to reach consensus about a given topic or concept. Concept mapping integrates group process activities (brainstorming, unstructured pile sorting and rating of brainstormed items) with several statistical analyses to yield both statistical and graphical "maps" of a conceptual domain. Concept mapping uses specialised computer software to undertake these analyses and has been used in a range of sectors to develop frameworks for evaluation. The domains of science capability generated by DPI concept mapping were compared with literature-derived domains and a simple integrated science capability framework has been developed.

The framework is consistent with the structure of the Australia Business Excellence Framework (ABEF) which has been adopted to guide continuous improvement in DPI. The identified domains in the science capability framework are: science capacity, science quality, science project management, utilisation of science findings, foresighting and generation of new ideas, and reputation. A series of indicators have been generated for each of these domains. While much of the data required to measure the specified indicators is currently collected by DPI through existing monitoring, management and reporting systems, validation of existing data is sought through an in-depth, but systematic, qualitative approach. As a result, two complementary data collection schedules have been developed:

- a schedule for collection of selected existing data
- a schedule for a representative cross section of DPI Victoria staff and stakeholders to undertake a self-assessment of science capability within their area, responding to a series of statements that reflect the domains of the science capability framework.

Data collection tools are undergoing piloting and revision prior to wider implementation later in 2005. The suitability of the framework for the MARD environment will be determined in 2006.

Project AH/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, East and Southeast Asia and the Pacific Regional Office, Vietnam
Project Leader	Dr Dai Peters Phone: (51-1) 349-6017 Fax: (51-1) 317 - 5326 Email: d.peters@cgiar.org
Collaborating Institutions	Research Institute for Legumes and Tubers, Indonesia National Institute of Animal Husbandry, Vietnam South Australian Research and Development Institute, Australia Food Crop Research Institute, Vietnam Provincial Livestock Department, Papua, 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)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

In Papua (Indonesia) and Papua New Guinea (the western and eastern components of the island of New Guinea) food shortages and malnutrition continue to be major problems, especially in the mountain areas where sweet potato (SP) is the principal staple food. Sweet potato is also the main feed source for pigs, which are raised throughout the island. Pigs are an integral part of the culture and political organisation of many New Guinea tribes; pork is a significant protein source for local people and is in high demand as a traded commodity.

Cash income has become increasingly important in the two regions with the penetration of regional and national markets, and pigs offer a good opportunity for income generation. However, the existing SP-pig systems exhibit several problems, notably low fertility and slow growth in pigs, which may be caused by unbalanced and erratic feeding regimes and health problems. Using an approach that is sensitive to the cultural role of these systems, it is proposed that technical interventions can be made through introduction of novel SP varieties and improvements to pig-raising management, leading to better food and feed productivity and positive benefits on family nutrition and income.

The project aims to assess, characterise and analyse the existing human-sweet potato-pig production systems in Papua within the overall household economy, in order to understand types of systems, their relative importance and their major constraints. Another objective was to improve sweet potato-based production and staple food and feed supplies for both Papua and Vietnam. A further objective was to improve the efficiency of indigenous, integrated pig-raising systems in Papua.

Project progress

Year 4 (01/01/2004-31/12/2004)

Objective 1: A series of multi-location trials to collect data required for registration of seven new and superior clones of sweetpotato have commenced. Trials are also under way to test the production and nutrient value of Musan, the best local variety used for pigs in Papua. Funding trials in North Sumatra, West Sumatra and Jambi Province supplement registration trials funded by the project in Papua.

Objective 2: A number of modified diets have been developed and are being validated in a series of feeding trials. The diets are based on sweet potato tubers and vines supplemented with salt and chopped banana trunks. The first diet developed was based on cooked sweetpotato tubers and vines

and this is being compared with two other diets. Growth rates of parasite pigs fed these diets ranged from 160 to 250g/day compared with 15 to 60 g/day for parasite free pigs fed traditional diets. As analysis of all the diets has shown them to be deficient in protein, other protein sources are being investigated. These include local fish species, pasture grasses and fodder trees. Nile tilapia (*Oreochromis niloticus*) is being investigated as a possible food source for pigs.

Objective 3: Sow productivity was improved by modifying the management of sows following weaning. In a trial involving 20 sows, 80% sows managed under the modified husbandry system mated within 8 days of weaning, compared with only 40% for sows housed traditionally. The former also produced 83% more weaned pigs. Based on these data, the economic advantage of the modified system will enable groups of farmers or clans to maintain their own boar, rather than borrow a boar from other farmers or clans. Trials designed to make further improvements in sow management were commenced towards the end of 2004. These include a comparison of feeding sows the diets based on ensilaged sweet potato tubers and vines and high protein pasture.

Objective 4: A modified husbandry system for growing pigs is also being designed and validated. Under this system, pigs are housed over night and allowed to forage pastures during the day. They also spend the first 30 minutes after release each morning in a special dunging area, designed to control parasites. The high protein pasture supplements the diets based on sweet potato tubers and vines. Confining pigs also prevents access to toxic plants, present in scrubland, and human and dog faeces, found in the traditional family compound.

Objective 5: The amount of training undertaken has also increased during 2004. As well as formal training, a significant amount of “unofficial training” takes place during each visit to the project sites, as well as during more official meetings. With 15 villages now involved in the project, this will provide a strong network of knowledgeable farmers for the “farmer-to-farmer” training programmes that will operate during the final 6 months of the project. More formal opportunities for training have also been provided to several farmers collaborating in the project, which has strengthened the project significantly. All the collaborating farmers have been trained in harvesting and planting sweet potato, preparing diets, feeding pigs, planting grasses and trees and designing and building lalekens. Several of the Indonesian scientists have also been given training in a number of areas. These include train-the-trainer and farmer-to-farmer training schemes operated in Vietnam and elsewhere in Indonesia, fish production in Java, and in the diagnosis of internal parasites.

Project CP/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 Fax: +60 3 89487655 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 Baños, Philippines Universiti Kebangsaan Malaysia, Malaysia
Project Budget	\$746,479
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The Asia–Pacific region has more than 400 tropical fruit species that can provide income, nutrition, medicine, timber, fuel and livestock feed. Only a few have been exploited commercially. Tropical fruit species and their wild relatives play an important role in stabilising and sustaining ecosystems, particularly in Asia. Several native species are rapidly approaching extinction; thus, there is an urgent need to conserve this diversity. However, many species of tropical fruit are difficult or impossible to conserve by traditional methods such as seedbanks or field genebanks, and there are currently no efficient, appropriate methods for their long-term, sustainable conservation. New *in vitro* technologies are therefore needed for conserving tropical fruit species. Such technologies are the subject of this project, which will complement an Asian Development Bank (ADB)-funded project, *Conservation and use of tropical fruit species biodiversity in Asia*, that is being implemented by the International Plant Genetic Resources Institute (IPGRI). The ADB project involves 10 countries, including the Asian countries involved in this project.

This project aims to conserve the genetic resources of selected tropical fruits and related species by developing new conservation methods and regeneration strategies, and disseminating these technologies to researchers and others within the Asia–Pacific and Oceania region.

Project progress

Year 2 (01/01/2004-31/12/2004)

Cryopreservation studies for the identified crops (mango, papaya, Australian native fruits, *Nephelium*, citrus, persimmon, litchi and longan) were performed using materials propagated earlier in the project. Somatic embryogenesis have been developed for *Citrofortunella microcarpa*, *Citrus reticulata*, *C. aurantifolia*, *C. sinensis* and *C. suhuiensis* and multiple shoot formation was obtained for *Citrofortunella microcarpa*, *C. reticulata* and *C. hystrix*. Protocols have been refined for micropropagation and shoot and plantlet regeneration via organogenesis of some Australian native fruits. Micropropagation and plantlet regeneration from *in vitro* nodal cuttings of three Australian Citrus species (*Citrus inodora*, *C. garrawayi* and *C. australasica*) has been achieved. Adventitious shoots were obtained for both litchi and longan. Persimmon callus was formed and used for cryo-assays. Adventitious buds were formed from embryonic shoots of persimmon.

Genetic fidelity testing for tissue cultured and non-tissue cultured plants of *Citrofortunella macrocarpa*, *C. reticulata*, *C. aurantifolia* and *C. grandis* were evaluated using 11 enzyme systems and no difference was found in banding patterns between tissue cultured and non-tissue cultured plants.

In developing cryopreservation techniques, seed desiccation sensitivity was tested for *Citrus reticulata*, *C. sinensis*, *C. medica*, *Citrofortunella macrocarpa*, *C. aurantifolia*, *C. hystrix* and *C. nobilis*

as well as for longan seeds and excised embryonic axes of persimmon. Experiments with desiccation of *C. australasica* seeds showed tolerance to ultra low temperatures and had normal morphology post-cryopreservation. In another study, the optimum duration was found for *C. reticulata* and *C. nobilis*.

Encapsulation dehydration (ED) and vitrification methods were tried for several Citrus varieties with successful recovery. The results suggested that ED may not be a suitable technique for cryopreservation of somatic embryos. Cryopreservation of embryonic axes of *C. grandis* using ED method was performed and the results provided initial data on the potential of cryopreservation of *C. grandis* embryonic axes. Promising results were obtained for *C. hystrix* as well, using the ED method. Cryopreservation of mature *Citrofortunella macrocarpa* seeds using desiccation proved to be a very simple method of preserving its germplasm. Embryogenic callus of Som-Keaw-Wan (*C. reticulata*) Som-Shokun (*C. reticulata*), Som Chengh (*C. sinensis*) were cryopreserved using the new ED method. Results showed that pretreatment affected the percentage of moisture content after desiccation in various time. The results of this experiment showed that the new ED method with pretreatment solution was better than conventional ED. For *C. reticulata* and *C. nobilis*, the pregrowth duration had significant effect on survival of its cryopreserved embryonic axes.

Papaya shoot tip cryopreservation protocol was improved to be applicable to a wide range of genotypes by optimisation factors influencing vitrification. Eight different genotypes were selected to compare the old and refined protocol and all were successfully cryopreserved with recovery rates varying from 36 per cent to 60 per cent.

Preliminary tests for cryopreservation of *Nephelium* were carried out. Progress on developing a suitable cryopreservation method for this difficult species has been made and the results obtained so far has provided guidance on the approach for further work. Fine suspension cultures of mangoes were cryopreserved and viable embryos were recovered post-cryopreservation.

Slow growth protocol was developed for mandarin by testing varying concentrations of mannitol and sorbitol. Using MS medium without growth regulator and supplemented with sucrose as carbon source slowed down growth of mandarin shoots. Slow growth protocols papaya plants *in vitro* were refined and cryopreservation of shoot tips and seeds achieved by using modified medium for the papaya micro-cutting system. Plants can be held for 8 to 12 months before transfer. The use of fructose in lieu of sucrose slows the growth considerably and allows incubation at 25°C. This is essential, as tropical species cannot be incubated at low temperatures due to tissue damage. Considerable progress has been made with experiments on papaya seed desiccation, germination and storage at different temperatures. It was found that desiccation below 15 per cent severely reduces germination percentage and that seed at any moisture content can be germinated with gibberellic acid or heat shock treatments. Seed that were stored for 1 month had germination percentages as high as 80 per cent.

Project LPS/2004/073: Capacity building on cattle production at Dong Giang district, Quang Nam province, Vietnam

Overseas Collaborating Countries	Vietnam
Commissioned Organisation	World Vision of Vietnam, Vietnam
Project Leader	Mr Andrew Catford Phone: 84 4 771 6230 Fax: 84 4 771 6225 Email: andrew_catford@wvi.org
Collaborating Institutions	
Project Budget	\$77,000
Project Duration	01/04/2005 to 31/03/2009
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

World Vision Vietnam has implemented projects for the poor in Dong Giang District (Quang Nam province, central Vietnam) to improve their living standards through activities such as health services, education and livestock development. This initiative will augment the World Vision Vietnam Area Development Plan by improving the capacity of World Vision staff and community leaders in administrating and managing projects.

Extension staff in the district and communes will gain in technical and extension knowledge. Local people will be exposed to applying suitable technologies to improve cattle productivity. It is anticipated that improved cattle production and increased income from livestock for participating households will be achieved within the project period, with wider scale benefits in the longer term.

Project progress

Year 1 (01/04/2005 to 31/03/2006)

The first progress report is due early in 2006.

Project PLIA/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: (63-2) 845 0563 , 812 7686 , 844 3351 ext 312 Fax: (63-2) 891 1292, 845 0606 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 Jeff Davis

Project background and objectives

Migration from farms, either to seek off-farm employment as an income supplement or to move to areas for greater opportunities is common throughout much of Asia. Off-farm employment is seen as a way to boost income particularly in smallholder family owned farms. This may increase income but at the cost of reduced farm labour inputs and the likelihood of reduced farm output. Increasing economic pressures from trade liberalisation, globalisation and their impacts, together with constraints from environmental, disease and weed pests and water availability are increasing trends to migrate and or to work off-farm.

The wider these pressures and their affects are felt, the greater the probability of reduced farm productivity impacting on the broader economy. The main group involved in migration and increasingly off-farm employment is men. This is resulting in far-reaching changes to household structures, and in cases of long-term or permanent migration, economic and social changes. Women are increasingly being left with the task of farm management, including having to overcome production constraints, mainly from lost labour inputs of husbands, brothers and other male workers.

Such changes are also occurring in some farming communities in Australia, creating many of the same issues. Little research has been done regarding these changes, their impacts and farm management. Of particular interest are technologies that can be used to alleviate production constraints caused by labour shortages, to help women in Asian and Australian farming systems to manage farms.

The overall goal of this project is to better understand the changes occurring in rural agriculture in Asia and Australia in relation to the changing role of women as a result of off-farm employment and/or migration and the ways in which constraints and needs differ between male and female household heads. In particular, the project will identify possible strategies and technologies to help women heads to better manage farms.

Project progress

Year 1 (01/01/2004 – 31/12/2004)

This report focuses on work to determine the occurrence and extent of work-related migration and off-farm work in major rice-based or mixed farming systems in Vietnam, Thailand, the Philippines, and Australia. The first-year activities included reconnaissance, a rapid rural appraisal (RRA), and focus-group discussions (FGDs) in the Philippines, Thailand, Vietnam, and Australia. The focus of the research in Thailand, Vietnam, and the Philippines is on the out-migration of individuals of farming households, while that in Australia is on the incidence of off-farm work. Research villages in Thailand, the Philippines, and Vietnam were selected based on criteria such as representing typical rice-growing areas under different water regimes (rainfed and irrigated) and access to labour markets (low

and high). A structured guide was developed for collecting village-level information, incidence of out-migration, patterns of migration, and characteristics of migrants. FGDs were conducted with key informants to gain perceptions on labour out-migration. Migrants are defined as those individuals who have changed residence for more than 3 months and send remittances. The incidence of out-migration was calculated among farming households, males, and females.

The results of the RRA showed that the proportion of households with migrants is higher in Thailand than in the Philippines and Vietnam. A higher proportion of males than females migrate in Thailand and Vietnam and vice versa in the Philippines. The incidence of out-migration is generally higher in rainfed ecosystems than in irrigated ecosystems. Rural to urban migration is prevalent in Thailand and Vietnam because of more employment opportunities in nearby districts and provinces brought about by rapid industrialisation and better communication and transportation facilities. In the Philippines, although rural to urban migration occurs, domestic to international migration is more prevalent. In Vietnam, men work as construction workers and masons in the cities and as hired fishermen, in seafishing, and with shrimp or squid catching in other provinces. Women work in waste trading and small trading, as hired labourers in rice farming, sand boating workers, domestic helpers, and factory workers, or in other industrial areas near rural areas. In Thailand, male and female migrants work as construction workers, factory workers, and in the trading/business and service sector. In the Philippines, female migrants mainly work as domestic helpers and entertainers within the Philippines and in the Middle East, Italy, Singapore, and Hong Kong. Others work as factory workers in Taiwan, Japan, and Korea. Male migrants work in the Middle East as construction workers, drivers, operators of heavy equipment, or seamen.

FGDs revealed that low rice productivity in the rainfed areas, the small size of landholdings, the lack of regular and alternative income sources, low profitability in rice farming due to high input costs, the desire of youth to seek adventure in the cities, and as a status symbol for a household to have a migrant abroad are some of the reasons for migration. Other reasons are the availability of non-farm work because of social networks, better wages, and the attraction of better living conditions in urban areas. Wives mentioned that remittances increase their income and enable them to invest in agriculture, repay their debts, and improve their living conditions. However, when husbands are absent on a long-term basis, the women face loneliness, insecurity, and emotional stress when remittances do not come on time for children's education, farm inputs, and other household expenditures. Women take on additional responsibilities of managing the farms.

It is clear that labour out-migration and/or off-farm work are occurring in all countries involved although the rates vary. The impact of family migration on agricultural productivity, farming efficiency, household welfare, and the changing role of women will be analysed in the next phase of the study.

Concluded projects

at 30 June 2005

Bilateral

AS2/2001/029	Development of a knowledge system for the selection of forages for farming systems in the tropics	85
FST/1998/096	Domestication of Australian trees for reforestation and agroforestry systems in developing countries	87

Project 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	Dr Bruce Pengelly Phone: 07 3214 2348, 0418 720 364 Fax: 07 3214 2308 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 Global Overseas Collaborators, Global
Project Budget	\$837,717
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

The demand for livestock products is expected to double by 2020. Smallholder farmers in developing countries, through more efficient and productive farming, will be able to benefit from this increase in demand. One way to achieve this is through planting well-adapted forages. However, it is often difficult for people in developing countries to identify and obtain the best possible forage. At present, much of the important information is fragmented, unpublished or published in media of limited circulation. A database is needed to capture the accumulated knowledge in a form that is applicable to all farming systems in the tropics.

The aim of this project is to develop a database that will help smallholder farmers in the tropics to select the best possible forage for their situation. The Selection of Forages for the Tropics (SoFT) database will allow smallholders to improve their productivity and thus benefit from an increasing demand for livestock products.

Project Outcomes

This project accessed the best available information for adaptation and use of 180 tropical forage species and their elite cultivars integrated in a single user-friendly database. The database, which includes a simple-to-use tool to assist in the selection of the best-bet species, is now freely available on the Internet (www.tropicalforages.info) and on CD.

The database has five main features:

- information in fact sheets on the adaptation, uses and management of forage species, cultivars and elite accessions;
- a selection tool built on LUCID that enables easy identification of best-bet species;
- a bibliography of more than 6,000 references and abstracts on forage diversity, management and use which will enable users with poor library facilities to access summaries of some of the key literature;
- global maps of climate adaptation for each species; and
- a collection of photographs and images of species to help in their identification and use.

The database selection tool is an expert system based on the experiences of forage specialists who have worked for many years in tropical and subtropical regions of Africa, lower latitude USA, Central and South America, South and South-east Asia and Australia. Selections were made on the basis of 19 criteria. The project brought teams of experts together in workshops in Africa, Asia, South

America, Central America, Europe and Australia over a two year period and had input from other forage specialists during the database development.

The principal outcome summarised information on tropical forage adaptation and use from expert knowledge, available literature and experiential sources made available in a readily accessible and consistent format. With availability on DVD and the Internet, the database allows researchers and advisors to select those forages most suitable for local conditions. Although the database was initially designed for use in developing countries, its content includes species adapted to farming systems in developed countries and is equally applicable in these regions. The database covers a wide range of forage uses and allows users to select among many different farming systems ranging from permanent to short term pastures, with applications in agroforestry, inter-row cropping, cut-and-carry, hedgerows, green manures and ground covers.

The database has been recognised as a valuable teaching tool for colleges and universities with feedback from many university staff from a wide range of countries attesting that the database and selection tool will have a major role in improving the way tropical forage science is taught.

The database was promoted during regional workshops, through partner organisations including CIAT and ILRI. The project team also conducted database demonstrations at the XX International Grassland Congress, held in Ireland in June 2005. Over 100 tropical forage agronomists trialled the selection tool and fact sheets. FAO became included in the project's partnership and agreement after discussions over the past 3 years. Involvement with FAO will further promote awareness of this database internationally.

The database resides on the CIAT Internet server and where it is maintained and updated. After a few months a need for information to be added to the fact sheets was identified and requests for additional funding have been made. CIAT is also exploring possibilities for the database to be translated into Spanish to encourage application in Latin America and the Caribbean.

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

Overseas Collaborating Countries	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 Fax: 02 6281 8312 Email: john.doran@csiro.au http://www.ffp.csiro.au/
Project Web Site	
Collaborating Institutions	Global overseas collaborators, Global
Project Budget	\$2,094,461
Project Duration	01/01/2000 to 31/12/2004 (Project extended from 01/07/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

In many countries people now face severe shortages of wood and wood products – through physical scarcity or because access to existing forest resources is restricted by commercial interests or government policies. Inadequate fuelwood compels poor people to collect fallen leaves and twigs for fuel from plantations, thereby disrupting nutrient cycling processes and impoverishing the soil.

Overall demand for fuelwood in the developing countries is expected to increase at an annual rate of 1.1 per cent; meanwhile, forest cover is steadily declining (in continental Southeast Asia at an average rate of 1.6 per cent per year). Land degradation and other changes brought about by reduced forest cover are causing substantial social, economic and environmental problems. Remaining natural forests and plantation forests are under greater harvesting pressure.

In many developing tropical and subtropical countries Australian trees have been planted (and are still being planted) to deal with the demand for forest products. The species are popular because many of them perform well on degraded, infertile sites, can deal with wide variations in climate and grow rapidly when the water supply is good. In developing countries around the world there are now more than 13 million ha of eucalypts, 2 million ha of acacias and 1 million ha of casuarinas in plantations, with many more Australian trees in agroforestry settings or scattered plantings.

But failure to use the best germplasm, and poor matching of species to the sites and to suitable uses for the product have over time reduced the benefits of using Australian trees. This domestication of Australian trees (DAT) project helped devise strategies to create more productive and sustainable planted forests in developing countries, using carefully selected Australian tree species. The work followed on from the earlier 'Seeds of Australian Trees' project funded by AusAID and ACIAR.

The major project objectives were to support more effective domestication and use of Australian tree species in low-income developing countries through provision of certified seed, training, and technical advice on the domestication and best use of Australian tree and shrub species.

Project outcomes

The main components of the project were seed supply, provision of technical advice and literature, and training. Research seedlots were sent to 44 recipients in 20 countries between January and December 2004. Developing-country researchers also received 87 copies of scientific and technical publications. Courses in Sri Lanka and Vietnam trained participants in seed orchard management and seed technology for seed orchards, including seed quality issues, seed collection, processing and documentation. A training course in Guangzhou, China, introduced software and methods for analysis of advanced-generation breeding populations.

Genetic gain trials established in the Philippines, India, Sri Lanka, Thailand and Vietnam enabled researchers to compare the performance of seed collected from in-country seed orchards established and managed by DAT collaborators with the original natural provenances used to establish the orchards as well as local commercial seed sources. These trials use large plot size (typically 36-tree or 49-tree square plots) and four or more replicates, in order to accurately rank the performance of the seedlots and determine whether trees grown from the seed orchard seedlots showed significant improvement in plantation performance. Two-year performance data from the genetic gain trials in the Philippines (*Acacia mangium*, *Eucalyptus urophylla*), Thailand (*E. camaldulensis*, two locations) and Vietnam (*A. auriculiformis*, *A. mangium*), and one-year performance data from Sri Lanka (*E. grandis*) were collated and analysed by partner organisations.

In summary, the studies found excellent performance of the orchard seedlots relative to natural provenance and commercial controls. The orchard seedlots were ranked best or close to best for height and diameter growth in all of these trials, and also displayed above-average survival. Treatment differences were statistically significant for most of the trials. For *A. mangium* in the Philippines the orchard seedlot had more than twice the 2-year conical stem volume of a locally used Mindanao land race of *A. mangium*, while in Vietnam the orchard *A. auriculiformis* had 38 per cent greater 2-year conical stem volume than the local commercial seed source, and significantly superior branching and stem straightness. In both these cases the orchard seedlots also significantly outperformed the natural-provenance controls, demonstrating that significant genetic improvement had been achieved in the orchards.

Partner research organisations in the collaborating countries are already using these results to promote the use of superior orchard seed over other local alternatives. Already in India small unreplicated demonstration trials of the orchard seedlots of *E. camaldulensis* and local alternative seed sources established on plantation company lands have led to strong commercial demand for seed from the DAT orchards.

Paclbutrazol treatment of eucalypt seed orchards in India, carried out during the project, led to substantial increases in flowering and seed production, and it is anticipated that this treatment will be used operationally to boost seed production of low-yielding species such as *E. tereticornis*. A new seed orchard of *E. tereticornis* was successfully established in Sri Lanka under the project, while in Vietnam clonal seed orchards of *A. auriculiformis*, *A. mangium* and *E. camaldulensis* were established in three locations across the country. The best 30 or so clones of each species, propagated from progeny trials, were established in a clone bank for intensive control-pollinated breeding, using clone bank technology transferred from CSIRO via the DAT project.

Project staff from CSIRO and from collaborating countries including China, Cambodia, India, Indonesia, Laos, Thailand, the Philippines and Vietnam attended a two-day meeting in Bangkok to review progress with domestication of key Australian species and plan for future collaboration after the conclusion of the project.

Projects under development

at 30 June 2005

Bilateral

ADP/2002/046	Agriculture and natural resources in central Vietnam
ADP/2002/092	Free trade agreements in East Asia – their effects on agricultural trade
ADP/2005/113	WTO accession and structural adjustment implications
AH/2004/040	The epidemiology, pathogenesis and control of highly pathogenic avian influenza (HPAI) in ducks in Indonesia and Vietnam
FIS/2005/114	New technology for edible oyster farming in Vietnam and Australia
FST/2002/112	Domestication of Meliaceae species in Southeast Asia and Australia, particularly management of the problem of <i>Hypsipyla robusta</i> attack
LWR/2003/035	Improving the utilisation of water and soil resources for tree crop production in coastal areas of Vietnam and New South Wales
PLIA/2005/061	Economic analysis of Vietnam's aquaculture industry
SFS/2003/060	Implementation of rodent management in intensive irrigated rice production systems in Indonesia and Vietnam

Multilateral

ADP/2005/063	Overcoming barriers to market access for smallholder pig producers in Southeast Asia
PLIA/2003/063	Increasing the effective use of livestock research for development in SE Asia

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. Publications 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 (Vietnamese edition available)
- 94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package
- 96 Rats, Mice and People: Rodent Biology and Management
- 97 Effects of Globalisation and Economic Development on the Asian Livestock Sector
- 98 Domestication of *Chukrasia*
- 99 Developing agricultural solutions with smallholder farmers (Vietnamese edition available)
- 100 Field methods for rodent studies in Asia and the Indo Pacific
- 110 Advances in grouper aquaculture
- 113 Worm control for small ruminants in tropical Asia
- 114 Diversity and management of Phytophthora in Southeast Asia
- 115 Nitrogen fixation in acacias
- 117 Selecting safer pesticides
- 119 Guidelines for surveillance for plant pests in Asia and the Pacific

Proceedings

- 31 Bacterial Wilt of Groundnut
- 45 Bacterial Wilt
- 50 Postharvest Handling of Tropical Fruit
- 58 Development of Postharvest Handling Technology for Tropical Tree Fruits
- 60 Postharvest Technology in Vietnam
- 61 Agricultural Impacts on Groundwater Quality
- 63 Matching Trees and Sites
- 66 Bluetongue Diseases in the Asia-Pacific Region
- 68 Exploring Approaches to Research in the Animal Sciences in Vietnam
- 71 Grain Drying in Asia
- 74 Sustainable Parasite Control in Small Ruminants
- 77 Breeding Strategies for Rainfed Lowland Rice in Drought-prone Environments
- 81 Disease Control and Storage Life Extension of Fruit
- 85 Seeking Agricultural Produce free of Pesticide Residues
- 86 *Leucaena*: adaption, quality and farming systems
- 89 Elimination of Aflatoxin Contamination in Peanut
- 94 Classical Swine Fever and Emerging Diseases in Southeast Asia
- 95 Working with Farmers: The Key to Adoption of Forage Technologies
- 97 *Hypsipyla* Shoot Borers in Meliaceae

- 98 Reservoir and Culture-Based Fisheries: Biology and Management
- 100 Quality Assurance in Agricultural Produce
- 101 Increased Lowland Rice Production in the Mekong Region
- 103 SADC Planning Workshop on Newcastle Disease Control in Village Chickens
- 105 Postharvest Handling of Fresh Vegetables
- 106 Water Policy Reform: Lessons From Asia and Australia
- 108 Development Strategies for Genetic Evaluation for Beef Production in Developing Countries
- 109 Inoculants and Nitrogen Fixation of Legumes in Vietnam
- 111 Eucalypts in Asia
- 116 Water in Agriculture
- 117 Control of Newcastle disease and duck plague in village poultry
- 118 Improving the management of irrigation schemes in Vietnam
- 119 Agriproduct supply chain management in developing countries
- 120 Spiny lobster ecology and exploitation in the South China Sea region

Technical reports

- 31 *Styrax tonkinensis*: taxonomy, ecology, silviculture and uses
- 37 Mycotoxin Contamination in Grains
- 45 Rodent Biology and Management
- 48 Genetic Transformation, regeneration and Analysis of Transgenic Peanut
- 49 Chukrasia: Biology, Cultivation and Utilisation
- 52 Rice–shrimp farming in the Mekong Delta:biophysical and socioeconomic issues
- 56 Feeds and feeding for inland aquaculture in Mekong region countries
- 58 Evaluation of International Provenance Trials of *Casuarina equisetifolia*
- 61 Production technologies for low-chill temperate fruit

Research notes

- 22 Management of Irrigation Areas: Irrigation Management in the Red River Delta of Vietnam
- 23 Measurement and maintenance of duck and hen egg quality in Vietnam
- 26 Non-chemical Control of Rodents in Lowland Irrigated Rice Crops (Vietnamese version available)

ACIAR Working Papers

- 53 Priorities for Pig Research in Southeast Asia and the Pacific to 2010
- 54 Mud crab aquaculture in Australia and Southeast Asia
- 57 A Survey of Marine Trash Fish and Fish Meal as Aquaculture Feed Ingredients in Vietnam