Country Profile

Indonesia

July 2004

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

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Preface

The ACIAR Country Profiles are designed as a snapshot of the collaborative research being carried out between Australia and our key partner countries. This publication contains short summaries of both bilateral and multilateral projects with Indonesia that were active at 30 June 2004. At that time there were 28 active bilateral projects and 5 active multilateral projects, the latter being led by an international agricultural research centre. There were another 13 projects under development (12 bilateral and 1 multilateral), many of which are expected to start in 2004–05.

This publication also sets out the key outputs and outcomes from 22 bilateral and 2 multilateral projects that have been completed since July 2002.

In addition to these project summaries, the publication includes an extract from ACIAR's 2002–03 Annual Report covering Indonesia, our near-term program as outlined in the 2004–05 Annual Operational Plan, and a record of the most recent consultations held between ACIAR and Indonesia on the medium-term priorities for the joint program.

ACIAR will produce a similar compilation of summaries each year and distribute them to key stakeholders in Indonesia and Australia.

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

Peter Core
Director

Mirah Nuryati
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July 2004

Indonesia Report 2002–03

(extract from ACIAR Annual Report 2002–03)

Number of projects active in 2002–03	53
Bilateral country expenditure in 2002–03	$4 062 457
Bilateral country expenditure in 2001–02	$4 784 157
Bilateral country expenditure in 2000–01	$3 475 852

Position

Indonesia is ACIAR's largest bilateral program and has more projects than any other partner country. The country's proximity and strategic importance to Australia, and the large proportion of its population relying on agriculture, mean that its prominence in ACIAR's program will continue. The agreed geographical focus of the collaboration continues to shift towards eastern Indonesia, in line with the emphasis of the Australian aid program. Most research capacity is in Java but ACIAR has made good progress to link this to eastern Indonesian institutions and to regional adaptive research agencies and planning authorities. The majority of projects developed since 1998 have strong eastern Indonesian components. ACIAR also targets Indonesia in its multilateral program, delivered in conjunction with international agricultural research centres such as the Center for International Forestry Research (CIFOR), the International Potato Centre (CIP) and the World Agroforestry Centre.

Achievements

ACIAR supports collaborative projects in both animal health and production. Diagnostic tests, based on enzyme-linked immunosorbent assay technology (ELISA) were developed for the detection of the antibody to jembrana disease virus, a significant health problem in Bali cattle in parts of eastern Indonesia. Training courses were conducted by the Disease Investigation Centre in Denpasar, to transfer the technology to regional laboratories. A vaccine trial demonstrated that immunisation with a recombinant protein vaccine provided immunity against Jembrana disease of cattle. Development of a number of options for control based on knowledge of the epidemiology of fasciolosis, which are appropriate for the farming systems in Southeast Asia, can help minimise the use of expensive anthelmintic drugs. Transfer of control recommendations to extension services is underway. The Research Institute for Animal Health in Bogor is now a reference centre for fasciolosis in Southeast Asia. In work on gumboro, a disease of poultry, a preliminary test to detect the presence of the most virulent form of the disease has been developed. Five strains have been identified including a dominant strain, which will be used in vaccine development.

A simple and practical method of overcoming the low reproduction rate of Bali cattle in mixed crop–livestock systems in eastern Indonesia has been demonstrated. After consultation with all farmers in Kelebub village in Lombok, the twin strategies of controlled mating (one bull, three-month mating period) and weaning of calves at six months were adopted. This resulted in cows in better condition that were less costly to feed, and calves growing better when fed appropriately. The controlled seasonal mating has been a further boon, with over 90 per cent of eligible cows producing a calf, compared with about 60 per cent under traditional management. A new project is being developed to scaleup this initiative to other villages where the strategies can be applied. Discussions with farmers at Kampung on Sumbawa (one of eastern Indonesia's transmigration areas) identified that a better rice variety for their upland conditions was the highest priority. A dozen accessions were assembled and established for the 2002 wet season and farmers made their selection. Seed was bulked up during the dry season, with the new variety achieving record yields, about 50 per cent higher than from the existing varieties, during the 2003 wet season.

Plant protection remains an important aspect of research activities. A project on *Liriomyza huidobrensis*, a new leaf-mining fly devastating many vegetables in parts of Asia, has uncovered much information about various pest leaf miners and their natural enemies. Information gathered through this project was able to help the Northern Australia Quarantine Strategy interpret results from some of their offshore surveys. A project on fungal diseases of significant crops in Indonesia has

identified the complex factors causing clove yield decline and vanilla stem rot, and the modes of spread of both diseases. Trials are now underway to design management strategies.

A 'National Rodent Management Program' (Gama Pamati) was developed based on recommendations arising from collaborative work funded by ACIAR in West Java. This program now forms the basis for the national policy on rodent pest management in Indonesia. This was based in part on research into ecologically-based rodent management that demonstrated consistent increases in rice yield (range 0.1 to 0.9 t/ha). Chemical usage amongst farmers involved in the project dropped from 98 per cent in 1999 to 46 per cent in 2002. A project to reduce incidences of disease and pest management problems of cocoa is examining resistance traits in cocoa varieties. Cuttings of promising varieties identified throughout Indonesia have been identified and collected, with cuttings grafted to existing trees at the trial site. Additional project work is determining the best methods of grafting cuttings, with preliminary results indicating improvements that can benefit local cocoa farmers, are possible.

Options for reducing contaminant risks in peanuts have been enhanced by market chain studies showing that most fungal contamination from aflatoxins occurs during postharvest handling and storage. Excessive contamination was not a problem in freshly harvested nuts, allowing research to focus on finding improvements in postharvest handling and storage systems to reduce risks to consumers. Alternatives to traditional cropping tillage practices on vertisol soils based on permanent raised beds, using vegetables like onions and chillies, are proving successful. The traditional 'gogorancha' methods produce lower yields and can damage the long-term sustainability of the vertisol soils.

Fisheries is ACIAR's largest program discipline in Indonesia. ACIAR and the Indonesian Ministry for Marine Affairs and Fisheries collaborated to present a major showcase of outcomes of almost two decades of jointly sponsored work in capture and culture fisheries. The showcase, held in Jakarta on July 31, attracted almost 400 participants including senior officials from government and industry. Five key project results were highlighted, covering the areas of shared fish stocks; grouper mariculture; illegal, unregulated and unreported fishing; remediation of degraded shrimp ponds; and shrimp disease control and management. All presentations, posters and information products were in Bahasa and English. The showcase generated strong commitment to continuing collaboration, with increased emphasis in future on applications of research and technology transfer.

An effective low-cost technique for the remediation of ponds in areas with medium or low levels of acid sulfate in soils has been developed and successfully trialled in southern Sulawesi. When exposed to air through excavation, the acid sulfate is released, leaching into ponds and waterways, significantly reducing productivity. The main cause of this leaching was identified as dyke soils rather than pond bottoms, which are often the focus of management. Modified dyke soil management strategies, using acid- and salt-tolerant species, dramatically reduced soil erosion.

Mono- or polyculture methods to growout shrimp, milkfish and seaweed have also been demonstrated for affected ponds. Geographic information systems (GIS) and remote sensing methods were successfully used to describe relationships between acid sulfate soil distribution and coastal landforms in Indonesia and to classify land suitable for shrimp production. Biological, physical and production indicators were also identified and integrated into simple site assessment techniques for farmers.

Nutrition research has identified many of the nutritional requirements of several species of high-value grouper, which has allowed the development of artificial (pellet) diets. Trials are now being undertaken with commercial feed companies to develop commercial grouper feeds. ACIAR also supported a request of the Indonesian Government to address a serious carp disease epidemic (Koi carp herpes) in Java. The outbreak represented a grave threat to common carp, a major food fish and source of cheap protein. ACIAR assisted Indonesian scientists to undertake a detailed disease survey, and provide training on the suite of epidemiological tools developed under a past project. This study will input directly into the development of a national control and management plan for the virus.

Project work in agricultural economics has advanced the development of a sustainable microfinance system for agricultural producers. The study showed that successful schemes needed to serve the wider community, not just farmers, and have low transaction costs. Dissemination of the research has included interactions with provincial government committees on the poverty alleviation program, as well as the Ministry of Finance to look at the model being applied nationally. The issue of whether farmers participating in contract farming were better off than those that did not was addressed through project work. The results showed lower transaction costs were a key aspect of the success of the contract under study, which provided a low-cost way for farmers to access the seed corn market. This allowed diversification in production, reducing risk, providing guaranteed prices and enhancing profitability. The involvement of grower groups also provided the contractor with benefits in terms of the costs of drafting, negotiating and enforcing the contracts.

Constraints to the development of the banana industry are being analysed, with a focus on markets. A workshop brought together key stakeholders from throughout the industry to develop a picture of the constraints throughout the supply chain. The result is a classification of the roles, resources used and barriers to productivity of the two main groups within the industry, smallholder farmers and larger commercial operations. A suitable model to test several improvements is now under development before application on a small scale to the smallholder sector.

A suite of forestry projects is underway, aiming at enhancing the sustainability of forestry resources through improved productivity and management. Domesticating Australian trees offers opportunities to improve the sustainability and profitability of Indonesia's forestry sector. A project focusing on the provision of seeds and technical support and training has supplied seed to 14 countries. Training and technical support have been provided, with a focus on establishing productive seed orchards, many of which are now producing seeds for *Eucalyptus* and *Acacia* species. Heartrot, which occurs when *Acacia mangium* is planted in Indonesia, is a significant barrier to using acacia wood for timber. Surveys of the incidence of heartrot in acacias show it is widespread, but have also revealed that its incidence increases dramatically in trees selected for characteristics associated with thin trunk growth. Some management techniques to increase these traits also increase the likelihood of heartrot. A separate project is using molecular technologies to develop more efficient breeding strategies for *Acacia mangium*. Screening of seed from eight provenances (locations from which the seed is derived) to determine rust susceptibility has been undertaken. Training in the microsatellite technology used has been passed on to the Indonesian project personnel.

Improving the broad-scale management of forests and of productive sectors of the forestry industry is also progressing. A project examining alternatives to traditional slash-and-burn agriculture has identified carbon stock accumulation in soils for the main cropping options practised. Of these options, shade-coffee crops provide the greatest levels of carbon storage in soils, minimising the levels of carbon reaching water supplies. Erosion control measures that suit these options, which also reduce carbon loss to water supplies, have been tested, with initial findings showing that the growth of plants, and even weeds, on these measures have the added value of acting as filters. Potential conservation measures based on local practices have also been identified, with computer modelling used to test the likely benefits on soil conservation. This has allowed various options to be matched to locations for field trials, which are now underway. A separate project focused on the essential oil industry in Indonesia has used seed collected from the Maluku Islands in Indonesia and parts of northern Australia to improve breeding, through screening of oil and growth characteristics. This included the planting of breeding populations and laboratory testing using gas chromatography. Thinning of breeding populations based on the best identified varieties and provenances is underway to allow for scaling up of seed populations for plantation planting throughout Java.

Indonesia Plan 2004–05

(extract from ACIAR Annual Operational Plan 2004–05

Population	211.7 million
GNI per capita	AUD 1,307

Indonesia: Bilateral research expenditure	$m 2002-03 actual	$m 2003-04 budget	$m 2004-05 budget	$m 2005-06 indicative
Active projects	4.06	3.84	1.29	0.40
Committed funds for new projects			2.51	2.60
Projects under design			0.48	1.10
Available for new projects			0.00	0.0-0.2
Total	4.06	3.84	4.28	4.1-4.3

Strategy

ACIAR's Indonesia program has a strong emphasis on agricultural research interventions to increase farmer and fisherfolk incomes, especially in eastern Indonesia. Projects aim to improve production systems for crops, livestock and forestry, to add value to Indonesian agricultural products and to develop export markets through greater emphasis on farming as agribusinesses.

Conservation of the resource base for agriculture will be assisted by research collaboration on aspects of crop, livestock and fish biological security, and through policy research that takes into account the implications of decentralisation for the sustainable management of livestock, fisheries, forestry and land resources.

Key performance indicators

- Maintenance of a strong program (at least as large as in 2003–04) and project pipeline
- More than two-thirds of projects initiated in 2004–05 have a significant eastern Indonesia component
- Identification of projects with potential for application as pilot community projects
- At least six new fisheries projects implemented
- Development of an integrated modelling toolkit for assessing risks and benefits of improved forage production in mixed crop–livestock farming systems
- Confirmation that the Indonesian Thin Tail Sheep has a strong resistance to Giant Liver Fluke
- Identification of optimum support systems for community forestry development in eastern Indonesia
- Permanent raised beds established as a viable alternative to highly labour-intensive tillage systems on vertisol soils in Lombok

Position

The country's proximity and strategic importance to Australia, and the large proportion of its population in poverty, mean that its prominence in ACIAR's program will continue. A key challenge for ACIAR and its partner agencies in Indonesia is to secure more practical outcomes for farming communities from what has been a considerable research investment. We will work with our Indonesian partners to involve end-users and extension groups during the development of research projects, to more closely integrate project personnel in project activities at the farming community level, and to integrate researchers and policymakers where appropriate.

Although special emphasis will be placed on development of projects and research capacity in eastern Indonesia in line with the emphasis of the overall Australian aid program (including Nusa Tenggara Timur, Nusa Tenggara Barat, Western Papua and Sulawesi), continued collaboration with research and development providers in Java and Bali is important. There is less Australian comparative advantage in collaboration with Sumatra and Kalimantan.

Most research capacity is in Java but ACIAR has made good progress to link this to eastern Indonesian institutions and to regional adaptive research agencies and planning authorities. The majority of projects developed since 1998 have strong eastern Indonesian components.

Fisheries projects have had significant impacts (management of shrimp diseases, rehabilitation of degraded or unproductive shrimp ponds on acid sulfate soils, mariculture of high-value fish and crustaceans, restocking of depleted fisheries, management of illegal, unreported and unregulated (IUU) fishing, and monitoring and harmonised management of shared fish stocks. Other imminent successes are in control of rodents in rice crops, biological control of weeds (eg *Chromolaena*) and liver fluke parasites of ruminants, transgenic resistance to peanut stripe virus, and rapid propagation of improved tea genotypes via tissue culture.

ACIAR also emphasises Indonesia in its multilateral program, delivered in conjunction with the international agricultural research centres, which include the Center for International Forestry Research (CIFOR), the World Agroforestry Centre (ICRAF), and the International Potato Center (CIP).

Indicative priorities

Priorities for collaborative agricultural research between Australia and Indonesia were discussed in August 2002 in Jakarta at a consultation between ACIAR and representatives of relevant Government Ministries and Agencies (including the Indonesian Agency for Agricultural Research and Development and the Agency for Marine and Fisheries Research), universities, the Indonesia Institute of Sciences (LIPI), the private sector and farmers' associations. Although not officially sanctioned priorities of the Government of Indonesia, they are priorities expressed by participants at the consultation, and ACIAR will use them as a reference when assessing project proposals. A full list of agreed priorities from the meeting is available at www.aciar.gov.au under Partner country priorities/Indonesia.

In eastern Indonesia, there are opportunities to capitalise on linkages between central research institutions (mainly based in Java) and location-specific adaptive research that directly addresses farmers' needs. More follow-up activities that enhance the transfer of technology of earlier ACIAR projects will be pursued, and opportunities for greater involvement of industry explored. In 2004-05, the collaborative program will emphasise animal health and production, crop protection, forestry, fisheries and agricultural economics. Agreed priorities within these program areas include:

Agricultural economics

- Impact of decentralisation on natural resource management and development of better management policies
- Impact of trade agreements on food security and incomes of small producers
- Empowerment of small producers in agribusiness for better access to production factors and market returns
- Structural adjustment options for agribusiness to optimise economic and social benefits

Animal sciences

- Development of sustainable crop−livestock systems
- Enhancement of Bali cattle productivity through improved management and genetic improvement
- Management of livestock diseases to improve production and establish market access and trade relationships
- Disease risk assessment and risk management to enhance the safety of foods of animal origin

Crop protection

- Integrated Pest Management, especially in soybean, potato, crucifers and other vegetables
- Rodent pest control, including strategies for management in upland crops as well as paddy rice
- Host plant surveys and pre-harvest control of fruit flies
- Diagnosis and control of Phytophthora on citrus rootstocks, potato and pepper, and management of major pests and diseases of bananas
- Information systems for quarantine

Fisheries

- Sustainable aquatic farming systems (genetic improvement, disease management, feeds and nutrition)
- Stock assessment and management of shared and common-interest fisheries (including policy level research, IUU fishing issues, and environmentally friendly fishing techniques)

- Management of inland open water fisheries, including aquaculture
- Improved processing, packaging and transport technologies which extend product life and increase market value

Forestry
- Development and domestication of eastern Indonesian species for income generation from non-timber forest products
- Species selection and breeding to support plantation development, with emphasis on indigenous species, land rehabilitation and environmental services in eastern Indonesia
- Development of tree farming models with improved smallholder−plantation company cooperation
- Improved utilisation and value addition of timber from fast-growing plantation species

Key program managers

Dr Ray Trewin, Agricultural Development Policy
Dr John Copland, Animal Sciences 1 (animal health and animal pests)
Dr Bill Winter, Animal Sciences 2 (animal production, crop−livestock systems)
Dr Wendy Morgan, Crop Protection
Mr Barney Smith, Fisheries
Dr John Fryer, Forestry

Country Manager

Ms Mirah Nuryati (Acting)

Active projects

at 30 June 2004

Bilateral

Multilateral

ADP/2000/072: Improving resource-use efficiency in the coconut industry of North Sulawesi and its national implications

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Sydney, Australia
Project Leader	Dr Lynn Henry Phone : (02) 9351-3492 Email : l.henry@agec.usyd.edu.au
Collaborating Institutions	Sam Ratulangi University, Indonesia Bogor Agricultural University, Indonesia Indonesian Coconut and Palmae Research Institute, Indonesia Research and Development Board of North Sulawesi, Indonesia
Project Budget	$396,157
Project Duration	01/01/2004 to 31/12/2005
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

The North Sulawesi coconut industry is beset by problems due to a downturn from the high level of economic development evident in regional areas of Indonesia over the past few decades. Rural labourers now have few opportunities for off-farm employment, leading to ever-increasing problems for small farms. This project aims to examine policy options for the North Sulawesi coconut industry. Researchers are building a small-scale model of the North Sulawesi economy to demonstrate the linkages between broader economic policies and the coconut industry, and to relate it to existing models of the Indonesian economy developed by previous ACIAR projects. Overarching objectives of the project are to assist in capacity building in agricultural policy at Sam Ratulangi University, and to encourage discussion between researchers and policy makers in North Sulawesi Province about broader economic development issues (and their links to the agricultural sector).

Project progress

First progress report is due in early 2005.

ADP/2002/012: Technical change in Thai and Indonesian agriculture: measurement, socio-economic impact and policy implications

Overseas Collaborating Countries	Indonesia, Thailand
Commissioned Organisation	Australian National University, Australia
Project Leader	Professor Peter Warr Phone : 02 6125 2682 Email : peter.warr@anu.edu.au
Collaborating Institutions	National Center for Genetic Engineering and Biotechnology, Thailand Chulalongkorn University, Thailand Bogor Agricultural University, Indonesia Centre for Agro-Socio Economic Research and Development, Indonesia
Project Budget	$399,799
Project Duration	01/01/2004 to 31/12/2006
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Research on the socio-economic effects of technology development is a high priority in Thailand. This project aims to identify those agricultural industries that have shown productivity growth and determine why they have grown - is it biotechnical change such as improved crop varieties and cultivation methods, mechanisation, management improvements, or other reasons? Researchers will examine the economic and social effects of this technological change, including effects on agricultural trade, income distribution and poverty. They will assemble a large data set encompassing eight major agricultural sectors and undertake a statistical analysis of the rate and factor-saving biases of technical progress in each sector. They will also update and enhance the general equilibrium model of the Thai economy developed in an earlier ACIAR project, and use it to predict the economic and social effects of technical progress in each sector.

Project progress

First progress report is due in early 2005.

AS1/1997/027: Genetic and immunological characterisation of high resistance to internal parasites in Indonesian Thin Tail Sheep

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Sydney, Department of Animal Science, Australia
Project Leader	Dr Herman Raadsma Phone: (02) 4655 0603 Email : raadsma@camden.usyd.edu.au
Collaborating Institutions	Monash University, Australia R&D Centre for Biotechnology, Indonesian Institute of Sciences (LIPI), Indonesia Central Research Institute for Animal Sciences, Indonesia
Project Budget	$1,710,431
Project Duration	01/01/1998 to 31/12/2004 (Project extended from 01/01/2003 to 31/12/2004)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

Fasciola gigantica (giant liver fluke) and *Haemonchus contortus* (barber's pole worm) are parasites of livestock that can live for many years in the liver and stomach, respectively, feeding on blood and tissues. Many of the parasitic infections occur in domestic farm animals in developing countries in the tropics, where drugs to kill the parasites are too expensive for the average smallholder farmer to access. These animals are important as a source of draught power, milk and meat.

A long-term, low-cost and sustainable approach could include increasing natural resistance of the animals that usually become affected. One of the ways to do this is to find animals that are naturally resistant to *F. gigantica* and *H. contortus* infection and find out why they are resistant. This project has identified such a resistant source of animals, namely the Indonesian thin tailed (ITT) sheep. Usually, these animals are resistant to infection because they express specific gene products (often proteins) to kill the parasites. Susceptible animals on the other hand do not make such molecules.

The aim of this project is to identify these genes and the corresponding molecules that control the resistance to parasite infection in these animals and to transfer this knowledge to improve the performance of susceptible animals by genetic selection (e.g. breeding or cloning), or through development of new drugs or drug targets that can affect protein expression and lead to increased resistance in animals.

Project progress

Year 6 (01/01/2003–31/12/2003)

The project is being conducted in two parts:
Subproject 1: To determine the genetic basis of resistance in ITT sheep to *F. gigantica* and *H. contortus*

To date researchers have generated 10 backcross families to show that resistance in the ITT sheep breed is controlled by a set of major genes on certain chromosomes. They have done this by mating resistant ITT sheep to susceptible Merino sheep, and backcrossing the heterozygous sires to susceptible ewes, in order for the resistant gene to be expressed. All progeny are challenged with parasites to obtain an expression of resistance. Previously they had confirmed the presence of major genes controlling resistance to *Fasciola gigantica* and *Haemonchus contortus* through segregation analysis. Preliminary QTL analysis suggested significant linkage of these resistance traits with polymorphic markers located on linkage groups 1, 5 and 10. This year they carried out phenotypic testing on the 200 progeny from the 2002 drop, which extends the progeny numbers of three of the 10 backcross families.

The final slaughter of the experimental animals was undertaken in late December 2003 and the livers processed for fluke counts. This now represents completion of the last of the large progeny cohorts for parasite challenge and phenotyping, bringing the total number of animals phenotyped close to 900 over the four groups. These individuals were screened, using approximately 70 DNA markers, and researchers have concentrated on adding new markers to three priority linkage groups (chromosomes) across the four families with large progeny numbers. This will enhance the scientists' ability to identify candidate genes of interest for further research.

Subproject 2: To characterise the immune mechanisms responsible for resistance of ITT sheep to *F. gigantica* in order to identify candidate gene(s).

The researchers sought to identify the genes responsible for resistance by looking at functional analysis of the parasite-killing mechanism through comparison of resistant ITT sheep and susceptible Merino sheep. They studied many molecules of the immune system and have already identified several proteins/molecules that can kill *F. gigantica*. This year they showed these differences are important in the development of immunity. They also studied whether molecules that prevent the parasites from dying differ when obtained from resistant ITT sheep rather than susceptible Merino sheep.

The researchers completed a large immunology experiment where animals (ITT and Merino) were challenged both with *Fasciola hepatica* and *Fasciola gigantica*, and slaughtered at different stages post infection for collection of critical tissues. Large-scale analysis of gene expression in these tissues by means of micro-array analysis and targeting of specific cytokine profiles via qRT-PCR is under way in 2004.

AS1/2000/009: Development of diagnostic and control methodologies for animal trypanosomiasis (Surra) in Papua New Guinea, Indonesia, the Philippines and Australia

Overseas Collaborating Countries	Indonesia, Papua New Guinea, Philippines
Commissioned Organisation	Murdoch University, Australia
Project Leader	Dr Simon Reid Phone: (08) 9360 7423 Email : sreid@central.murdoch.edu.au
Collaborating Institutions	Research Institute for Veterinary Science, Indonesia Dinas Peternakan, Irian Jaya, Indonesia National Agriculture and Quarantine Inspection Service, Papua New Guinea University of Southern Mindanao, Philippines Department of Agriculture, Region XI, Philippines Balai Penyidikan Penyakit, Sulawesi, Indonesia
Project Budget	$399,880
Project Duration	01/01/2001 to 31/12/2005 (Project extended from 01/01/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

Animal trypanosomiasis (Surra) caused by *Trypanosoma evansi* is endemic throughout Southeast Asia and an important constraint to productivity of smallholder livestock. It is prevalent in the Philippines and Indonesia, but has not been detected in PNG and Australia. There is a wide host range, and both native marsupial animals and livestock would be affected if it entered Australia. This project aims to: enhance capability for effective surveillance of surra in Papua, PNG and the Philippines through development and transfer of new diagnostic technologies; identify genetic markers for pathogenicity in *T. evansi* and investigate their usefulness in predicting outbreaks of clinical disease; test the effectiveness of existing trypanocidal drugs and new candidate compounds in treating *T. evansi*. Scientists from Murdoch University and Balitvet are introducing diagnostic tests for *T. evansi* to collaborating institutions through hands-on workshops and in-country training.

Project progress

Year 3 (01/01/2003–31/12/2003)

Transfer of existing technologies

The final project workshop was attended by project staff from Indonesia, the Philippines, Papua New Guinea and Australia as well as scientists from the Northern Australian Quarantine Strategy (NAQS) and the Northern Territory State Government. Project outputs were presented and discussed in the context of the priorities of each partner country. Information suitable for dissemination at the smallholder level was identified and data suitable for publication were also identified.

Application of molecular techniques to improve the accuracy of diagnosis of *T. evansi*

This aspect of the project has progressed well and a prototype sample collection kit using Whatman FTA Cards has been developed and provided to project participants in Mindanao for evaluation. In addition, veterinary staff members from NAQS have purchased FTA cards and preliminary evaluation in their program in East Timor has confirmed their suitability for use to collect blood samples for surveillance for surra and other blood-borne infections. The use of FTA cards to collect blood samples in remote areas will significantly enhance surveillance for *T. evansi* in Australia and PNG.

Results of testing tissue samples from animals experimentally infected with *T. evansi* showed that lung and heart, in particular the heart valve, were positive on more occasions than other tissues and blood. This information has been provided to veterinary staff at NAQS because it will ensure the

correct samples are collected during surveys of wild or feral animals in Australia and PNG where individual animals are killed and samples taken post mortem.

Determine genetic basis for intraspecific variation in pathogenicity

There is insufficient data to determine the genetic basis for differences observed in the pathogenicity of *T. evansi* in mice. Genetic differences have been identified between isolates of *T. evansi* from Indonesia, the Philippines and Kenya (as part of a related project), showing correlation between differences in the epidemiology of infection in camels and geographic separation in Kenya, while differences in Indonesia correlate with geographic separation.. It is difficult to interpret results from the Philippines because there are only a limited number of isolates from two regions of Mindanao.

Evaluate the efficacy of existing trypanocidal drugs for the treatment of *T. evansi*

Four separate experiments were conducted at Balitvet to determine the comparative sensitivity of 5 isolates of *T. evansi* from different geographic locations in Indonesia to three trypanocidal drugs (diminazene aceturate, quinapyramine, cymelarsan). Only cymelarsan was deemed suitable for further evaluation in large animals because both diminazene and quinapyramine failed to cure all animals, even at high potentially toxic dose rates, and quinapyramine caused overt signs of toxicity at sub-curative doses. No signs of toxicity were observed with cymelarsan.

Epidemiology of infection with *T. evansi* in Mindanao

Good progress was made in collecting data to determine some of the risk factors associated with *T. evansi* infection in Mindanao. A large data set was collected from longitudinal surveys of 50 cattle owners and 50 buffalo owners from Matalam and Kabacan. The set contained information on the prevalence of infection with *T. evansi,*, factors relating to the individual livestock and their management by farmers, and information about social factors such as household income and education levels. Results show that the prevalence of infection in Kabacan has decreased markedly from 2001 to 2002.

Data analysis showed that carabao (buffalo) owners who also own goats are twice as likely to have animals that register positive to the *Card Agglutination Trypanosoma Test* (CATT), and that farmers with only elementary education are five times more likely to have CATT-positive animals compared to farmers who have secondary level education. There is also a weak association between increasing income and increasing likelihood of having CATT-positive buffaloes. These results show that communication packages must focus on farmers with elementary-level education to ensure the greatest impact. More data on other management factors are required to interpret the significance of goats and household income in the epidemiology of infection with *T. evansi*.

A Microsoft Access database has been developed to store information on the frozen isolates of *T. evansi* held at Balitvet, allowing this valuable resource to be used more effectively to study *T. evansi*. Project researchers at Murdoch University have developed a mouse model with similar features to ruminant surra in Mindanao. This research tool will be used to develop tools and methodologies for the study of the pathogenesis of surra as well as tests to detect infection.

AS1/2000/029: Production of a vaccine for the control of Jembrana disease in Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Murdoch University, School of Veterinary Studies, Australia
Project Leader	Professor Graham Wilcox Phone: (08) 9360 2448 Email : gwilcox@central.murdoch.edu.au
Collaborating Institutions	Disease Investigation Center Region V1, Indonesia LIPI, Indonesia Research Institute for Veterinary Science, Indonesia Center for Veterinary Biologics (Pusvetma), Indonesia
Project Budget	$1,049,275
Project Duration	01/07/2001 to 30/06/2004
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

The Indonesian government is using Bali cattle as the major large ruminant breed for development of smallholder and commercial cattle production. This project will build on earlier work that established the feasibility of experimental vaccination to protect Bali cattle from Jembrana disease. The scientists are developing and testing a recombinant virus protein vaccine and a DNA vaccine for Jembrana disease in Bali cattle and also test a closely related vaccine for Bovine Immunodeficiency Virus of cattle. They will establish a protocol for vaccination against Jembrana disease in cattle and facilitate quality control and production of the vaccine by government and private enterprise.

Project progress

Year 2 (01/07/2002–30/06/2003)

One objective of the project was to improve the capability of Indonesian scientists to diagnose Jembrana disease in Indonesia, especially to provide techniques that could be used in regional Disease Investigation Centres. This has been achieved. Clinical and histological diagnostic tools were backed up with specific methods involving immunological techniques with specific Jembrana disease virus monoclonal antibodies and *in situ* hybridisation methods. An ELISA test developed for serological surveillance is now in routine use; this is a marked advance and improvement on earlier more laborious and protracted methods. Efforts continue to develop a serological test that will differentiate antibody to the pathogenic Jembrana disease virus and the non-pathogenic Jembrana disease-like virus detected in Sulawesi.

A second objective was to characterise the non-pathogenic Jembrana disease-like virus detected in Sulawesi, to transfer this virus infection to cattle in Bali, and then examine the interaction between the pathogenic and non-pathogenic forms of Jembrana disease virus in Bali cattle. It was hypothesised that the non-pathogenic form would provide cross-protective immunity against the virulent form of Jembrana disease virus infection. Serological tests had indicated a close relationship between the two different pathotypes, but so far it has not proved possible to transmit the infection from adult sero-positive cattle in Sulawesi to donor cattle in Bali by direct transfer of blood. Efforts continue to accomplish transmission and characterisation of the non-pathogenic virus in Sulawesi.

A third and major objective was to develop vaccines to control Jembrana disease from viral proteins produced using recombinant DNA technology. Two major experiments have been conducted and results were extremely promising, even though the immunisation regime was conducted over a short period (for logistic reasons). These vaccine experiments are continuing with an increased dose and an extended immunisation regime.

The fourth major objective was to test the hypothesis that DNA vaccination, alone or in combination with recombinant protein vaccines, could be used to control Jembrana disease. Although this was planned for the final year of the project (2003/2004) methods of delivery and preliminary assessment of the efficacy of vaccination have already been determined.

AS1/2000/083: Development of a vaccine for the control of Gumboro in village and small poultry holdings in Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Livestock Industries, Australian Animal Health Laboratory, Australia
Project Leader	Dr Jagodina Ignjatovic Phone : (03) 5227 5769 Email : Jagodina.Ignjatovic@csiro.au
Collaborating Institutions	Research Institute for Veterinary Science (BALITVET), Indonesia
Project Budget	$398,174
Project Duration	01/01/2001 to 31/12/2005 (Project extended from 01/01/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

Very virulent Infectious Bursal Disease (vvIBD—known locally as Gumboro), a viral disease of poultry, is a relatively recent introduction to Indonesia. Australia does not have vvIBD and AQIS considers it a high quarantine risk. This project builds on AusAID support for the CSIRO Australian Animal Health Laboratory (AAHL) to work with BALITVET to define the importance and widespread incidence of vvIBD virus throughout Indonesia. Currently, Indonesia relies on imported vaccines and one vaccine made locally under license. But smallholders refrain from using vaccine because of variable quality and because they are packaged in commercial doses of 1000 when they only require 20. This project is developing a master vaccine seed from local vvIBD strains, validating the level of protection provided by the test vaccine, then developing an ELISA test to gauge effectiveness of experimental vvIBD vaccines and an antigen test for differentiating between vvIBD virus and classical IBD virus strains.

Project progress

Year 3 (01/01/2003–31/12/2003)

Two vvIBDV strains were selected as candidates for vaccine development. After more than 30 passages in tissue culture the virulence of one strain was reduced for chickens and commercial broilers. However this preparation was still too pathogenic to be used as a vaccine. Therefore the two strains were further passaged in tissue culture. Both strains were also cloned in order to insure that the vaccine contained a single, genetically uniform virus population. All viruses were characterised at the molecular level during passaging to monitor genetic changes that were occurring and to achieve desired genetic changes in the virus.

In total, five viruses at different passage levels and with different genetic characteristics were selected for trials in specific pathogen-free chickens. Samples collected from poultry flocks in Indonesia with Gumboro-like mortalities, and typed by an ELISA to be vvIBDV, were genetically characterised. Sequencing confirmed the ELISA results as suspected samples had almost identical sequences to those of other vvIBDV viruses isolated previously in Indonesia. Additionally, an experimental IBD killed vaccine was also prepared. This vaccine will be trialed in breeder hens to booster their IBD immunity and to provide protective maternal antibodies to hatching chicks until the age of their first IBD vaccination.

AS2/1999/060: Control of bees and bee mites in Indonesia and the Philippines

Overseas Collaborating Countries	Indonesia, Philippines
Commissioned Organisation	CSIRO Entomology, Australia
Project Leader	Dr Denis Anderson Phone: (02) 6246 4148 Email: Denis.Anderson@csiro.au
Collaborating Institutions	National Beekeeping Centre, Perum Perhutani, Indonesia Don Mariano Marcos Memorial State University, Philippines Dinas Peternakan Propinisi Dati I, Indonesia University of the Philippines at Los Baños, Philippines
Project Budget	$580,206
Project Duration	01/07/2001 to 30/06/2004
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Two genera of parasitic mites of bees (Varroa and Tropilaelaps) have a pathogenic effect on bees and pose a significant constraint to honey production in some of Australia's neighbouring countries. They would seriously threaten Australia's honey industry (as well as those industries relying on bees for pollination) if they became established here. The project's broad aims are to test a cheap, effective and appropriate control measure and to develop genetic markers that will allow the origin of the mites, and bees that spread them, to be identified. The markers will assist Philippine and Indonesian authorities to make decisions about the feasibility of eradication campaigns and/or the scope of control programs, and will strengthen Australia's capability to deal with future exotic incursions. Through its various activities the project also aims to generate and support local capacity to undertake and promote control programs and to continue research.

Project progress

Year 2 (01/07/2002–30/06/2003)

During the second year further progress was made to develop the use of formic acid (FA) as a cheap, effective and safe method for controlling the parasitic bee mites *Varroa destructor* and *Tropilaelaps clareae* on European honey bees (*Apis mellifera*) in Indonesia and the Philippines. FA is used in developed countries to control the varroa mite (*Varroa destructor*) on *A. mellifera*, but control relies on using a 65% concentrate, which is dangerous to human health and strongly corrosive to hive equipment, particularly in humid regions. Findings from the first year of this project indicated that it might be possible to use low concentrations of FA to control bee mites in hived *A. mellifera* colonies provided that air-flow in the bee hives was increased (to improve FA vapour production) and that treatments be applied for longer than treatments that use high concentrations of FA (to allow for longer contact between the FA and mites). Hence, during the past year, studies were directed at developing a hive design for applying low concentrations of FA and planning experiments to test its effectiveness.

The hive design devised for applying low concentrations of FA involved replacing the bottom board of *A. mellifera* hives with deep wooden trays that could each hold 3 litres of dilute FA solution but maintain a distance of between 5 and 10 cm from the top of the FA solution to the bottom of brood frames. This modification increased airflow within the hives and prolonged exposure of bees to FA. Gauze-covered division boards separated the wooden trays from the brood boxes, thus preventing bees from falling into the FA. The front end of each division board was removed to allow bees to enter their colony. A small raised platform was also built into each tray so that a sticky trap could be attached to the platform to monitor for mite-drop after each treatment. Trays were constructed by each collaborating organization in Indonesia and the Philippines and experiments to test their effectiveness are in progress.

Also during the second year, further information was obtained on the genetic diversity among Asian bees and their parasitic mites, together with information on bee/mite host/parasite relationships. Techniques were developed for determining the levels of genetic variation among populations of *Tropilaelaps clareae* on their natural bee host, *A. dorsata* (the giant Asian honey bee) and on their recently acquired bee host, *A mellifera*. These techniques were also used to examine the genetic variation among *A. dorsata*.

Samples of *T. clareae* were collected from *A. dorsata* and *A. mellifera* colonies from various parts of Asia along with samples of adult *A. dorsata* worker bees. All samples were transported to Canberra, where they are currently being identified and typed. To date, several different genotypes of *A. dorsata* have been found, each carrying its own particular genotype of *Tropilaelaps* mite. This early finding has important ramifications for beekeeping in Asia and for quarantine in Australia. This work will continue during the third year.

Bee/mite host/parasite relationships were examined to resolve the taxonomy of *Varroa* mites in the northern Philippine island of Luzon (the Luzon 1 and Luzon 2 genotypes) and for 1 taxonomically unresolved *Varroa* mite in the southern Philippine island of Mindanao (The Mindanao genotype). The Luzon 1 and 2 genotypes of *Varroa* were found to be specific parasites of the Luzon 1 and 2 genotypes of *A. cerana* respectively. Evidence indicated that these two mites couldn't utilise *A. mellifera* as an alternative host because they lacked the ability to reproduce on that bee. The Mindanao genotype of *Varroa* was found to be specific to the Mindanao genotype of *A. cerana* and evidence also indicated that this mite couldn't reproduce on *A. mellifera*. These findings lend support to the reclassification of these mites as stand-alone species.

AS2/2000/103: Developing an integrated production system for Bali cattle in the eastern islands of Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Queensland, Australia
Project Leader	Associate Professor Dennis Poppi Phone: (07) 3365 2573 Email : d.poppi@uq.edu.au
Collaborating Institutions	Universitas Nusa Cendana, Indonesia Queensland Department of Primary Industries and Fisheries, Australia University of Mataram, Indonesia Assessment Sub-Institute for Agricultural Technology, Indonesia
Project Budget	$399,870
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

There are limited data on the make-up of the Indonesian herd, but one source indicates over 2.5 million head of Bali cattle in Indonesia, mostly in the eastern islands where they are best suited to the harsh climatic conditions and poor nutritional status of feeds. Over the past decade, as the demand for beef has increased and large numbers of Bali cattle have been exported for slaughter to more urbanised areas of Indonesia, the Bali cattle herds on most of the eastern islands have been over-exploited and total numbers have decreased.

ACIAR plans to support several avenues to redress this problem. This project was initiated to develop strategies to deal with the reduction in the availability of Bali cattle for the Java markets and the reduction in the weight of the available cattle. The project is evaluating management that can sustain high reproductive output and evaluating diet management strategies that together provide the basis for genetic improvement and nutritional management to overcome the primary problems. The new and available information will be incorporated into an extension package. This work complements diet management studies in Australia, and the development of a breeding and genetics extension package for north Australian cattle producers.

Project progress

Year 2 (01/01/2002–31/12/2002)

Cattle management

The project has developed an integrated management system based on bull management, controlled natural mating, weaning, and strategic supplementation, with bull supply and weaning the most important. Two villages on Lombok and two villages on Sumbawa were studied. One village on each island had some aspect of the management package implemented whilst the other villages followed their usual management. Cows are highly fertile but bull supply is erratic and feed supply and quality in the late dry season can be extremely low. Weaning removes nutrient demand from the cow. Scarce resources of high quality feed can then be directed towards the calf. New management in this situation achieves higher weaning rates of 80%. Production indices have been defined. Heifer fertility is always low and cow weaning percentage is variable depending on region. Growth rate of weaners is up to 350 grams/day but usually much lower.

Diet management studies

In Indonesia, supplements have been evaluated for the newly weaned calf and the cow at two locations—University of Mataram, Lombok and University of Nusa Cendana, Kupang, West Timor.

For the calf, a high-quality forage is more effective than supplements. Lower amounts of high quality forage should be directed to the calf rather than the cow. Tree legumes and urea/sulfur supplements of rice straw are the cheapest and most effective; supplements of rice straw or dry-season sorghum grass sustain the cow in the late dry season. Weaning reduces feed demand of the cow, allowing limited resources of high-quality forage or supplements to be directed towards the calf. The cow generally can now fit in with the local feed supply without needing supplements. A new method (urinary purine derivative excretion) has been implemented to measure microbial protein production. Most situations indicated that rumen function was sub-optimal.

Extension package development

In Indonesia, the project team surveyed perceptions and social issues relating to Bali cattle production. Village demonstration was an important means of gaining information. Young people and women had different perceptions to men but had variable roles depending on the island. All were averse to risk and spending money or adopting a practice that might delay mating and a calf. The project initiated, in collaboration with Central Lombok Dinas Peternakan, a bull competition which proved to be a successful extension tool for the project. The competition identified good bulls and could be used as a future procedure in bull selection and breeding enterprises. The Australian technical extension package is well advanced and the approach has provided a format to implement the Indonesian work.

Capacity building

Several post-graduate students were trained in both Indonesia and Australia. An Australian Youth Ambassador for Development (AYAD) spent 6 months on the project and was responsible for the social impact survey with special reference to young people and women.

A detailed economic model was developed to investigate the effect of the management system. The model demonstrated better cash flow and gross margins under the new management system. The economic model identified some policy aspects and biological constraints that impact on profitability and also influence the risk aversion of villagers. An owner/manager was much more profitable than a manager (who does not own the cow). Weaning age, weaning percent and growth rate of the weaned calf are major biological constraints to profitability

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

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

Project background and objectives

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

Project progress

Year 1 (01/07/2002–30/06/2003)

Objective 1. To develop a knowledge system for the identification of forages suitable for specified niches within smallholder farming systems

There have been three major tasks associated with this first project objective:1) Selection of the parameters and states to be used in the selection tool and the information to be provided in the major SoFT output, the fact sheets associated with each species; 2) Design of the selection tool (acting upon dot point #1); 3) Acquisition of information from experienced agronomists and from the literature.

The attributes to be used for forage selection and the key elements (criteria and states for each criterion) of information to be recorded on database fact sheets were decided in a design workshop held in Bangkok in October 2002. That workshop was attended by the project management team plus forage agronomists from China and Thailand (a total of 12 agronomists) as well as Dr Peter Horne, CIAT, Laos.

A critical outcome of the workshop was the decision that the final project product would feature static GIS output rather than have a dynamic GIS facility. Any dynamic facility, while achievable, would have has very poor resolution because of the lack of detailed data inputs available. It was thought that there was a risk that potential users of the SoFT product would tend to apply the outcomes despite the poor resolution with potentially poor selection being made. Rather, it was agreed to include into the SoFT database outputs from current GIS research being conducted by Dr Michael Peters and Ms Rachel O'Brien at CIAT.

Following on from the Bangkok meeting, the design of fact sheets, selection criteria has been finalised and these designs incorporated into the LUCID selection tool, which has now been demonstrated at workshops to indicate the forage data and selections that are now possible as a result of the information obtained from the early data acquisition activities. The data input tool and a 'fact sheet

builder‘ (which enables easier compilation of fact sheets within the predetermined template) have been developed and options investigated for the internet version of the database.

The major task of assembling data commenced in 02–03 at a series of workshops. By June 2002 a total of about 100 species had been reviewed, together with data and expert comments on adaptation and utilisation for each forage. In addition to the data assembly from experienced agronomists at these workshops, major reviews of a range of published literature have commenced in Australia and Africa (ILRI) with the aim of producing a bibliography for each species in the database. This literature review is aimed at both the traditional scientific literature and less well known literature such as annual reports from various research projects.

Objective 2. To promote the system within the ’communities‘ that are using tropical forages

The major activities under this objective have been undertaken in parallel with the regional workshops. In excess of 40 agronomists attended project workshops, followed by an additional 40 that attended workshops in Asia, the Americas and Europe by January 04. The project leader also visited FAO and demonstrated the LUCID SoFT prototype in October 02.

Objective 3. To develop a strategy for maintenance and updating the knowledge system

Discussions are under way between FAO and the project team about new options for maintenance of the Database. It is hoped that FAO will take a lead role in partnership with CIAT to maintain the database. Dr Stephen Reynolds, FAO, Rome, is keen to collaborate and to link this database to the FAO databases.

ASEM/2002/066: Economic potential of land-use change and forestry for carbon sequestration and poverty reduction

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of New England, Australia
Project Leader	Dr Oscar Cacho Phone: (02) 6773 3215 Email: ocacho@pobox.une.edu.au
Collaborating Institutions	NSW Agriculture, Australia Centre for Socio Economic Research on Forestry, Indonesia World Agroforestry Centre, Indonesia
Project Budget	$400,000
Project Duration	01/07/2003 to 30/06/2005
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Indonesia has great potential to capture benefits via carbon sequestration payments for land-use change and forestry (LUCF) projects. The country could sequester between 5400 and 14,000 million tonnes of carbon through new growth and slower deforestation between now and 2050 (second only to Brazil). However, there is a considerable gap between this potential and what is likely to occur under current institutional conditions. The key is to find ways to reduce transaction costs and overcome other barriers, by developing standard, simplified ways of designing, registering and managing LUCF projects in exchange for carbon-credit payments. Researchers are investigating how to determine the most appropriate change of land-use and the administrative arrangements for channelling payments to individual smallholders in tropical Indonesia and temperate Australia. They are using an approach based on existing models rather than developing new complex models—the only option given the long time frames involved.

Project progress

First progress report is due in July 2004.

CIM/1996/140: Biological threats to *Saccharum* germplasm and sugar production in Papua New Guinea, Indonesia and Australia

Overseas Collaborating Countries	Indonesia, Papua New Guinea
Commissioned Organisation	Bureau of Sugar Experiment Stations, Australia
Project Leader	Dr Robert Magarey Phone : 07 4068 1488 Email : rmagarey@bses.org.au
Collaborating Institutions	Indonesian Sugar Research Institute, Indonesia Ramu Sugar Ltd, Papua New Guinea
Project Budget	$825,583
Project Duration	01/07/2000 to 31/12/2005 (Project extended from 01/07/2003 to 31/12/2005)
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Sugar cane had its origins in Papua New Guinea and Papua, and a rich diversity of wild germplasm is still present there. But environmental disturbances and the introduction of exotic pests and diseases pose major threats to this region as well as to Australia. This project involves a survey of major diseases and insect pest species that will be undertaken from Irian Jaya through PNG to Australia's northern coastline. The scientists will also determine the effect of each pest and disease on the sugar cane and decide the best means of respective control. The project involves upgrading of laboratory facilities in PNG and Papua, and provision of extra training for local quarantine personnel and researchers.

Project progress

Year 3 (01/07/2002–30/06/03)

Updated pest and disease listings for each country

This is important for targeting quarantine strategies and developing appropriate controls. Surveys have been undertaken in PNG (2001), northern Australia (2002), Indonesia (2002) and Cape York and the Torres Strait (2003). These have provided an important understanding of the distribution of major pests and diseases in the region. No other coordinated sugarcane survey of the region has ever occurred. The surveys highlighted the following:

- Ramu stunt, a major PNG disease, was found to be much more widespread in PNG than previously thought;
- No smut or ratoon stunting diseases was found on the PNG survey, across northern Australia (except for smut at the known infestation on the Ord River) or on Cape York or the Torres Strait.
- The Indonesian survey highlighted that movement of sugarcane smut had occurred eastward from Java, closer to PNG and the eastern Australian industry. This had occurred with the spread of hybrid (commercial cultivar) material. Quarantine procedures in the region need to be improved.
- The disease leaf scald has also spread east from Java in the same material.
- The widespread movement of hybrid sugarcane within the region was obvious. In PNG, villagers in even remote outer islands were growing sugarcane obtained from commercial crops at Ramu Sugar. This not only means that some chewing canes (*S. officinarum*) had been displaced, but that the potential for spread of several major diseases from the commercial cropping estate to disease-free areas was now significant.
- The Cape York survey highlighted the lack of significant quantities of sugarcane between the cropping areas around Mossman and the garden canes in the Torres Strait Islands.

- The finding of the planthopper *Eumetopina* at Bamaga (tip of Cape York) in just a couple of gardens, coupled with its isolated occurrence in the Torres Strait, suggests that eradication from the mainland of Australia is a real possibility.
- The need for further quarantine training/materials. Two training workshops were held for Torres Strait and PNG staff but there remains a need for more training in both of these locations. There is a definite need in Indonesia. The spread of sugarcane from Java to the eastern islands of the Archipelago and to Papua is a grave concern and more work is needed in this whole region.

Sensitive assay for Ramu stunt

This is important for quarantine purposes in germplasm exchange between countries/regions. Attempts to identify the causal agent have so far been unsuccessful. A phytoplasma has been reported associated with the disease by another research group but this cannot yet be confirmed. Research so far has identified some unique tiny nucleic acids.

Resistance screening test for *Sesamia grisescens*

Screening is needed at Ramu Sugar to improve the viability of its cropping industry. Research has proved fruitful in identifying resistance to the borer and in advancing the development of a resistance-screening test. Plant parameters that may be measured to determine the resistance of canes are being identified. Lack of borer infestation in the most recent trials has hindered progress.

Training of quarantine staff

There were two important training sessions: in November 2002, AQIS officers from all parts of the Torres Strait were trained in pests and diseases of sugarcane in a workshop on Thursday Island; later that month PNG quarantine staff attended a three-day training workshop at Ramu Sugar. Here they saw major pests and diseases in the field and were exposed to important aspects of the project work. They left with a much clearer understanding of the significance of *Saccharum* germplasm in PNG, the need for good quarantine protocols, the importance of their role in quarantine and the nature of the pests and diseases of sugarcane within the region.

Pest and Disease Manuals

Accompanying each training workshop was the distribution of the first sugarcane pest and disease manuals for both the Torres Strait and PNG. These will provide an ongoing source of information for quarantine officers.

On-going smut resistance screening

Screening is critical to industries in Australia and Indonesia, to help prevent large industry losses. Research has concentrated on storage of smut spores for resistance screening trials. The resistance screening has been ongoing, with over 900 clones now screened. Results have been good, and are being used to help the Australian industry prepare for a disease incursion.

The Indonesian Sugar Research Institute has also established resistance-screening trials for ratoon stunting disease (RSD) and leaf scorch, a leaf disease that recently spread from Malaysia into Indonesia. The Institute has also embarked on an industry survey for RSD, and the disease is one of their most important. The RSD assay laboratory, established with ACIAR funding, will be central to this work.

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

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

Project background and objectives

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

Project progress

Year 1 (01/07/2002–30/06/2003)

The project started at the University of Queensland (UQ) in July 2002. The collaborating partners started their involvement in early 2003. Experiments on embryo transplantation, embryo culture, somatic embryogenesis and molecular analysis of tissue-cultured plantlets have all taken place at UQ in the past year. The first coconut seedlings, following embryo transplantation, have now been successfully produced in the glasshouse. The transplantation technique used still requires improvements and will be the subject of overseas collaborative work with the partners in the coming year.

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

University team members have adapted their somatic embryogenesis protocol, previously developed for zygotic tissue explants, and are using it on explants from imported inflorescence tissues. At the moment the procedure has a very low efficiency rate. Medium additives such as coconut water and lauric acid have improved the rate of success but no significant results have been achieved. From other studies, preliminary results indicate that abscissic acid (AbA) could improve the development of somatic embryos from inflorescence tissues. A protocol for DNA extraction and purification has been optimised for coconut tissues. Good visualisation of DNA can be obtained using approximately 15 to

20 ng of DNA per reaction. Other DNA samples have been imported from CICY, Mexico. We are now analysing them for the methylation polymorphisms that may exist between clones.

In Indonesia, PNG, Vietnam and Philippines, the embryo culture research activities were still at an early stage of development. The initial work aimed to prepare sufficiently large numbers of germinating embryos for their future work needs on improving seedling establishment rates. The early studies undertaken will include those manipulating the culture medium to aid root system development, for producing a good shoot mass to root mass ratio, and those aiming to develop better acclimatisation steps. The germinating embryos, presently being established, will grow for up to one year before they can be used in such experimentation. Therefore, the results will only become available in the second and third years of the project.

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

Meetings took place at the collaborating partners' laboratories (PNG, Vietnam and the Philippines) to sharpen the focus of the project program. A new internet discussion group 'ACIAR coconut' was established to facilitate information exchange among the team members involved in the 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: (02) 4570 1287 Email : a.beattie@uws.edu.au
Collaborating Institutions	Gajah Mada University, Indonesia CSIRO Entomology, Australia Southern Fruit Research Institute, Vietnam National Institute of Plant Protection, Vietnam Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, Vietnam
Project Budget	$639,639
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

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

Project progress

Year 1 (01/01/2003–31/12/2003)

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

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

Dr Holford and Dr Beattie visited Vietnam from 5 to 10 October 2003 to review project protocols and continue planning of experiments. Dr Beattie also discussed these plans with project personnel during other non-project visits. Dr Mabberley helped to prepare a list of plants (citrus and citrus allies) to test as hosts for huanglongbing and the Asiatic citrus psyllid (*Diaphorina citri*), and to resolve uncertainty about relationships between these plants—an issue vitally important for the assessments.

CP/2000/090: *Liriomyza huidobrensis* leaf miner: developing effective pest management strategies for Indonesia and Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Department of Primary Industries, Victoria, Australia
Project Leader	Dr Peter Ridland Phone: (03) 9210 9222 Email : peter.ridland@nre.vic.gov.au
Collaborating Institutions	CSIRO Entomology, Australia Sam Ratulangi University, Indonesia Bogor Agricultural University, Indonesia International Potato Centre, Indonesia Udayana University, Indonesia Hasanuddin University, Indonesia La Trobe University, Australia
Project Budget	$399,812
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/07/2003 to 31/12/2004)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

The leaf-mining fly *Liriomyza huidobrensis*, an insect from the Americas, has become a notorious pest of many vegetables in other parts of the world as it has invaded new territory. It recently reached Indonesia, where it has devastated many vegetables including potato, and it threatens Australia. Attempts by Indonesian farmers to control the pest with chemicals have been ineffective and costly, and will soon lead to resistance developing. This project is studying the distribution of the leaf miner, and of its natural enemies (wasp parasites) in western and eastern Indonesia, and improving skills of Indonesian scientists in managing insecticide resistance and in studying pesticide resistance in parasitoid wasps. Scientists are developing alternative Integrated Pest Management strategies to manage the problem and provide knowledge of the pest and its controls before it reaches Australia.

Project progress

Year 3 (01/01/2003–31/12/2003)

Liriomyza huidobrensis, commonly known as potato leafminer fly in Indonesia, has become a major problem in potatoes and many other vegetable and flower crops grown in many highland areas in Indonesia since 1994. *Liriomyza sativae,* vegetable leafminer, is also now well established in lowland areas in Indonesia where it is a major pest of beans, tomatoes and cucumber. *Liriomyza chinensis,* onion leaf miner, has continued to spread in lowland areas of West and Central Java where it is found in damaging numbers on shallots. In 2003, it was found in some highland areas in West Java. Another two leafminer species were identified for the first time in Indonesia. These species, *L. katoi* and *L. yasumatsui* probably originate from Japan. They appear restricted to chrysanthemum, wild chrysanthemums and other Compositae. The females of these two species are very similar to another important polyphagous pest, *L. trifolii*, and their discovery has highlighted the need for rapid molecular diagnostic tests. So far, these two species have only been found in North Sulawesi. None of these important *Liriomyza* species have yet been recorded in Australia.

A measure of control can be obtained through wasp parasites. Analysis of the survey data on the distribution of leafminers and their parasitoids in vegetable crops in West Java, North Sulawesi, South Sulawesi and Bali has shown that *L. huidobrensis* is mainly found above 1000 m above sea level (asl), whereas *L. sativae* is generally restricted below 700 m. asl. However, there is very little overlap between the two species. Specific experiments are being undertaken to resolve the confounding effects of elevation and host plant on the distribution of both leafminer species and their most abundant parasitoids.

The LUCID keys being constructed for leafminer parasitoids and for economically important leafminers are continuing to be refined. In addition, two taxonomic papers describing new species of

leafminer parasitoids from Indonesia and Australia have been written. The braconid parasitoid, *Opius* sp., has increased in abundance in the highland areas of West Java and Bali, but not yet in South Sulawesi where *Hemiptarsenus varicornis* remains the dominant species. In Central Kalimantan, the main parasitoids of *L. sativae* on yard-long bean, French bean and cucumber were *Asecodes deluchii*, *H. varicornis* and *Chrysocharis* sp.

Insecticide susceptibility data for three populations of *L. huidobrensis* for abamectin, cyromazine and dimehypo have been analysed and accepted for publication. The response of *H. varicornis* to cyromazine, abamectin and mancozeb has been studied in Indonesia and Australia. It was clear from these trials that there were no sub-lethal effects of the commonly used fungicide, mancozeb, on *H.varicornis*.

Studies of the population dynamics of *L. huidobrensis* in unsprayed commercial potato crops in West Sumatra and South Sulawesi concluded in the third year of the project. The trial crops continue to be troubled with severe infections of late blight. Detailed analysis of these data is being undertaken. The impact of predatory flies (*Coenosia* sp.) was unclear in these trials. Postgraduate students at Bogor Agricultural University are completing detailed studies on the biology of *Gronotoma micromorpha* and *Asecodes deluchii*.

CP/2000/094: Diagnosis and control of soilborne fungal diseases of plants in Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Sydney, Faculty of Agriculture, Australia
Project Leader	Professor Lester Burgess Phone : (02) 9351 2526 Email: l.burgess@agec.usyd.edu.au
Collaborating Institutions	Sam Ratulangi University, Indonesia Royal Botanic Gardens, Sydney, Australia
Project Budget	$399,884
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Soilborne fungal diseases can cause serious yield losses but are hard to identify. It is suspected that many crops suffer from them but the symptoms can be very general. The project is concentrating on four target crops important to the economy of Sulawesi—cloves, vanilla, maize and sago—all of which suffer losses that appear to be caused by soilborne fungi. The overall goal of this project is to develop research and plant disease diagnostic capacities in east Indonesia, in particular North Sulawesi. Scientists aim to diagnose the diseases, suggest appropriate control measures, provide education and training on soilborne fungal pathogens and establish a local facility for ongoing research.

Project progress

Year 3 (01/01/2003–31/12/2003)

Other than routine disease surveys of general crops in North Sulawesi, research activities during the reporting year were mainly focused on further understanding of the two most important diseases in this region, clove yield decline and vanilla stem and root rot. A good knowledge of the biology of these diseases is crucial for the implementation of disease management strategies, which will be the focus of the following year's activities.

A quantitative survey of the disease incidence and severity of yield decline revealed that >90% of clove farms throughout North Sulawesi were infected at various levels of disease severity. Pathogenicity results of *Ceratocystis* on clove from the previous year were verified on mature trees (>15 years) in the field. Symptoms were observed to be clearer on mature trees. The fungus had been initially identified as *Ceratocystis* sp., but with the aid of molecular techniques was described as a new species, *C. polychroma* sp.nov. (the scientific publication of this is in preparation).

It was also established that the relationship between the insect borer *Hexamitodera semivelutina* and the pathogen was not an obligate and intimate association. Infection of *Ceratocystis* was shown to occur in the field independent of the insect borer. Spores of the fungal pathogen were shown to be carried by other animals (insects, nematodes and mites) inhabiting and foraging within the borer galleries. It was also observed that not all trees affected by the insect borer were infected by *Ceratocystis.* However, field observations indicated that the progress of the disease within the tree after the initial infection was greatly enhanced by insect borer activities.

For stem and root rot of vanilla, the pathogen *Fusarium oxysporum* f.sp. *vanillae* was shown to have the ability to remain within the host as an endophyte without showing any internal or external symptoms. Such endophytes could become pathogenic when the environment is favourable for disease development. This has significant implications for the management of this disease as all vanilla vines in this region are vegetatively propagated. The pathogen was also shown to have a very low level of genetic diversity throughout North Sulawesi.

A secondary disease on vanilla associated with stem and root rot is anthracnose caused by *Colletotrichum gloeosporioides*. Since the *Glyricidia* shade trees used to support the vanilla vines

often showed anthracnose symptoms on the leaves, it was thought it could be an inoculum source of the disease on vanilla. However, isolation and identification of the pathogen showed that the anthracnose symptoms on *Glyricidia* leaves came from a different *Colletotrichum* species.

During the year Ir Frans Rondonuwu and Ir Berty Assa attended a 10-week course at the University of Sydney. The course included conducting a small research projects, with the focus on mycological and molecular techniques commonly used in plant pathology research. Ir Frans Rondonuwu has now enrolled in a Master's program at UNSRAT, co-supervised by the project leaders and collaborators. As well, Ir Arthur Pinaria was awarded an ACIAR John Allwright Fellowship and will undertake a PhD research program at the University of Sydney.

FIS/1997/022: Remediation and management of degraded earthen shrimp ponds in Indonesia and Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of New South Wales, Australia
Project Leader	Dr Jesmond Sammut Phone: (02) 9385 6211 Email: j.sammut@unsw.edu.au
Collaborating Institutions	Australian National University, Australia Research Institute for Coastal Fisheries, Indonesia Assessment Institute for Agricultural Technology, Indonesia University of Western Sydney, Australia University of Hassanudin, Indonesia Center for Soil and Agroclimate Research, Indonesia NSW Fisheries, Australia Central Research Institute for Fisheries, Indonesia
Project Budget	$679,413
Project Duration	01/07/1998 to 31/12/2004 (Project extended from 01/07/2001 to 31/12/2004)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Shrimp farming is important in many parts of Asia as well as being a growing industry in Australia. However, production losses are occurring because of degradation of the ponds. In Indonesia, a major cause of degradation is the increasing acidity of the water because of the presence of acid sulfate soils. Ponds excavated in these soils start off performing well but quickly decline as acidity and toxic metals build up. The purpose of this project is to develop ways of remediating abandoned or degraded shrimp ponds using low technology that is readily affordable and easily applied. The work is focusing on acid neutralisation, water level management, the use of various capping agents to go on top of the soil, and soil conservation strategies.

Project progress

Year 4 (01/07/2001–30/06/2002)

The project scientists have developed methods to remediate and manage shrimp ponds degraded by acid and metal contamination associated with acid sulfate soils and to minimise the effects of soil erosion through pond soil conservation strategies. Hydrogeochemical studies of dyke and pond soils in Australia and Indonesia have described, in detail, the processes that cause pond degradation. The studies found that dyke soils are a major contributor of acid and metals, due to their capacity to generate large amounts of proton and mineral acidity through pyrite oxidation and metal hydrolysis respectively.

Field and laboratory-based studies, as well as hydrogeochemical modelling, were used to calculate more effective lime application rates for commonly used soil types and varying levels of existing acidity and acid producing potential. Liming strategies were developed in combination with pond preparation methods such as fertilisation, drying and flushing. Different types of commercially available lime and modified application strategies were tested for their efficacy, firstly under laboratory conditions and then in the field through a complete production period.

Rapid bioassays and toxicological studies tested the survival of shrimp exposed to leachate from treated soil. Treated pond soil leachate and effluent were monitored and assessed to prevent offsite pollution and toxicity to the farmed shrimp. The study showed that the integration of lime into dyke soil materials was more effective than the standard method of liming the first 10 cm of surface sediments. Where reconstruction of dykes is not possible, the liming and pond preparation strategies developed under the program nevertheless created significant improvements in pond production. The efficacy of

lime was increased by using fine-grained lime and when possible applying additional lime in a slurry to avoid loss by wind erosion and to improve seepage into the soil. Slurry mixtures also reduce micro encapsulation of lime granules, improve solubility and reduce loss by wind action.

Survival rates of up to 90% were achieved in formerly abandoned and low-yielding ponds. Improved liming and pond preparation strategies reduced soil pH and associated metal contamination of pond waters, increased survival and growth rates in shrimp and improved the density of beneficial algal blooms. By contrast, ponds treated by standard practices produced lower yields, experienced significant problems with metal contamination, and the depletion of phosphate which is scavenged by metals in the pond soils.

Three alternative farming systems were trialled for severely degraded ponds in Indonesia. Juvenile shrimp production in net enclosures provides a low risk alternative to monoculture. Production periods are limited to 21 days to manage risk associated with fluxes of acid and metals. Juvenile shrimp are a profitable alternative to complete monoculture growout because of the demand for juvenile shrimp by farmers operating ponds unaffected by acid sulfate soils. Net enclosures improved disease management and harvest, and also enabled farmers to move stock during period of poor water quality. Milkfish (*Chanos chanos*) and seaweed (*Gracilaria verrucosa*) culture were found to be sustainable alternatives to more risky shrimp monoculture (full growout) due to their higher tolerance to acid and metals.

Simple field techniques to identify acid sulfate soils were developed based on biological, physical and production indicators. A brochure and poster outlining field assessment methods were developed to assist farmers. Improved site selection criteria that address acid sulfate soil assessment were developed to enable farmers, extension officers and consultants to evaluate the suitability of sites for new ponds. GIS and Remote Sensing techniques, soil assessment and geomorphology were used to develop protocols for land capability assessment to map and classify land to assist environmental decision making in aquaculture development programs.

FIS/2000/061: Development and delivery of practical disease control programs for small-scale shrimp farmers in Indonesia, Thailand and Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	NSW Fisheries, Regional Veterinary Laboratory (RVL), Australia
Project Leader	Dr Dick Callinan Phone: (02) 6626 1294 Email : callind@agric.nsw.gov.au
Collaborating Institutions	Directorate General of Fisheries, Indonesia Network of Aquaculture Centres in Asia Pacific, Thailand (and India) Asian Institute of Technology, Thailand James Cook University, Australia Queensland Department of Primary Industries and Fisheries, Australia Aquatic Animal Health Research Institute, Thailand Department of Fisheries, Western Australia, Australia Central Research Institute for Fisheries, Indonesia
Project Budget	$1,014,019
Project Duration	01/07/2001 to 30/06/2005
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

During the past decade, recurrent disease outbreaks, particularly viral diseases, have caused catastrophic losses in farmed marine prawns throughout the Asia–Pacific region. Consequently many smallholders, who comprise the vast majority of shrimp farmers in Asia, have suffered significant hardship and incurred heavy debts—in many cases causing abandonment of the farm. This situation, together with a general lack of scientifically based disease control and prevention programs, now threatens the survival of the industry in many growing areas. Cost-effective farm-level disease control and prevention programs are essential for reducing losses to acceptable levels, restoring confidence and promoting sustainable development of the industry. In this project scientists are developing and validating farm-level disease control programs for smallholders, demonstrating their effectiveness, and extending them using methods designed to ensure widespread adoption. Targeted are semi-intensive (Indonesia), intensive (Thailand, Australia) and extensive (India) pond production systems.

Project progress

Year 2 (01/07/2002–30/06/2003)

The project has two parts, the ‘core project’ covering activities in Indonesia, Thailand and Australia, and the ‘NACA collaborative component’ covering activities in India. The NACA linkage has proved very important to the success of the core project, in that important technical and extension-related information from the Indian work, which began in 2001 under a separate NACA/MPEDA project, has been available one year in advance of similar activities within the core project.

During 2002, project shrimp crop failures sounded a clear warning of the technical difficulties ahead. In response, at the annual project coordination meeting in May 2003, the project team developed a list of mandatory program components for implementation on project farms in Thailand and Indonesia. To assist full implementation of this protocol, six Indonesian laboratory technicians participated in a PCR methods workshop, held at Mahidol University, Bangkok in September 2003. During the year scientists also modified some initial principles and assumptions underpinning the project. Specifically these related to: farmer attitudes to maximizing profits; definitions of ‘successful’ crops; changes to species farmed; the potential to amplify project impact through linkages with related government programs.

By January 2004, program validation trials in Indonesia and Thailand had been completed in a total of 27 (14 and 13, respectively) ponds. A number of factors, including the round 1 crop failure, limited pond stockings and a changed extension approach contributed to this total being lower than the originally predicted 45–50 ponds. Overall in Indonesia, 10 ponds have produced successful crops (four of which were 'major' successes), and four have failed. This represents a 70% success rate, , which is close to the target 80% expected at the beginning of the project. In Thailand, full validation trials were conducted during 2003 only and results differed markedly between provinces.

Project extension activities began their scheduled expansion during 2003. In both Indonesia and Thailand, central and provincial extension teams, with strong links to public and private sector providers, were established. Activities focused on technology transfer to participating key farmers and on demonstrating results, positive and negative, to local farmer groups. Emerging market requirements associated with food safety, trace-ability and certification are placing additional constraints on the small-scale, commercial shrimp farming sector. In this environment, opportunities for important synergies between the project and related programs became apparent during 2003.

In Indonesia, Directorate General Aquaculture intends using the project as a model for wider implementation of shrimp farm biosecurity initiatives, including their 'good aquaculture practice' (GAP) program. In Thailand, the project will promote development of high quality shrimp production 'clusters', with links to relevant government programs. Specific extension plans for all participating countries in 2004–5 were developed at a joint extension workshop.

FIS/2002/019: Management and policy frameworks for illegal, unreported and unregulated (IUU) Fishing in Indonesian and Philippine waters

Overseas Collaborating Countries	Indonesia, Philippines
Commissioned Organisation	University of Wollongong, Centre for Maritime Policy, Australia
Project Leader	Professor Martin Tsamenyi Phone: (02) 4221 3224 Email : martin_tsamenyi@uow.edu.au
Collaborating Institutions	Department of Foreign Affairs, Maritime and Ocean Affairs Centre, Philippines Agency for Marine and Fisheries Research, Research Centre for Capture Fisheries, Indonesia
Project Budget	$399,530
Project Duration	01/07/2003 to 30/06/2006
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The international community has identified Illegal, Unreported and Unregulated (IUU) fishing as one of the more serious fisheries problems requiring urgent action by nations around the world. The Philippines and Indonesia are particularly concerned about the impacts of IUU Fishing as combined losses to their respective economies are estimated to be over US$3 billion per annum. This project arose from the recommendations of an earlier small ACIAR project that identified researchable options to combat IUU in both the Philippines and Indonesia and to implement the FAOI endorsed International Plan of Action on IUU Fishing. The research is encouraging greater bilateral cooperation and consultation on IUU, facilitating policy reform and developing legislative frameworks in each country, and facilitating development of a regional National Plan of Action on IUU fishing.

Project progress

First progress report is due in July 2004.

FIS/2002/083: An assessment of the patterns of genetic diversity and stock structure in wild populations of the giant freshwater prawn (*Macrobrachium rosenbergii*): A resource for improving culture stocks in Indonesia and the Philippines

Overseas Collaborating Countries	Indonesia, Philippines
Commissioned Organisation	Queensland University of Technology, School of Natural Resource Sciences, Australia
Project Leader	Dr Peter Mather Phone: (07) 3864 1737 Email : p.mather@qut.edu.au
Collaborating Institutions	Research Institute for Freshwater Fisheries, Laboratory of Molecular Biology, Indonesia Bureau of Fisheries and Aquatic Resources, National Freshwater Fisheries Technology Research Center, Philippines
Project Budget	$97,708
Project Duration	01/07/2003 to 31/12/2004
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The giant freshwater prawn (*Macrobrachium rosenbergii*) is the sixth largest (in volume) aquaculture species in Asia. It is both an important commercial species (notably in Taiwan, China, Thailand, India and Indonesia) and a significant cash crop for many poor farmers throughout Asia and the Pacific. Over-exploitation, environmental pollution and habitat loss have threatened wild stocks of *M. rosenbergii* in many parts of Asia, but little is currently known about the levels and patterns of genetic diversity that exist in wild stocks of the species. This knowledge is vital for developing appropriate wild stock management plans and as basic information for stock improvement programs for culture. This project is compiling basic data on the levels and patterns of genetic diversity in wild *M. rosenbergii* stocks across the species natural range in the Asia–Pacific. In addition, the partner institutions in Indonesia and the Philippines are receiving training in the analysis, interpretation and application of such data sets to increase their capacities to undertake further studies.

Project progress

First progress report due in July 2004.

FIS/2002/111: Culture, capture conflicts: sustaining fish production and livelihoods in Indonesian reservoirs

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Deakin University, School of Ecology and Environment, Australia
Project Leader	Professor Sena De Silva Phone: (03) 5563 3527 Email : sena@deakin.edu.au
Collaborating Institutions	Network of Aquaculture Centres in Asia Pacific, Thailand Directorate General for Aquaculture, Indonesia Central Research Institute for Capture Fisheries, Indonesia Research Centre for Marine Fisheries Product Processing and Socio-Economics, Indonesia Marine and Freshwater Research Institute, Australia
Project Budget	$398,840
Project Duration	01/01/2004 to 31/12/2006
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Cage culturing of captured fish of inland reservoirs has become a widespread practice in parts of Indonesia. While this provides a valuable income source it is increasingly at the expense of wild fisheries in the same waters. Overstocking of fish in cages, thus creating pressure on feed supplies, is resulting in a growing number of fish kills, an event where large numbers of both wild and capture stock die. It can then take several months before stock levels are replenished. This project aims to develop suitable management plans for reservoirs, by determining optimal levels of caging, levels of wild stocks, and management plans for both wild and caged fish.

Project progress

First progress report due in early 2005.

FIS/2003/037: Artisanal shark and ray fisheries in Eastern Indonesia and their relationships with Australian resources

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Steve Blaber Phone: (07) 3826 7200 Email: stephen.blaber@csiro.au
Collaborating Institutions	Research Centre for Capture Fisheries, Indonesia Directorate General of Fisheries, Indonesia Research Institute for Marine Fisheries, Indonesia Queensland Department of Primary Industries and Fisheries, Australia Murdoch University, Australia
Project Budget	$619,966
Project Duration	01/01/2004 to 31/12/2006
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Sharks and rays (elasmobranchs) are widely fished as target species and caught as by-product in Indonesian and Australian waters. Worldwide there is increasing concern over the exploitation of elasmobranchs, resulting in FAO and international guidelines that specify the need for countries to develop a management plan. A previous ACIAR project collected information on elasmobranch fauna, biodiversity and socio-economic importance to artisanal fishermen. Building on this research will allow Indonesia and Australia to jointly manage shared elasmobranch stocks and also help Indonesia establish a National Plan of Action. Part of program includes technical training in biological disciplines for Indonesian partners, enhancing the country's stock assessment capability.

Project progress

First progress report due in early 2005.

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

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

Project background and objectives

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

Project progress

Year 4 (/1/01/2003–31/12/2003)

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

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

FST/2000/001: Impacts of fire and its use for sustainable land and forest management in Indonesia and northern Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Charles Darwin University, Faculty of Science, IT and Education, Australia
Project Leader	Professor Greg Hill Phone: (08) 8946 6550 Email: greg.hill@cdu.edu.au
Collaborating Institutions	Bushfires Council of the Northern Territory, Australia Wira Wacana Christian School of Economics, Indonesia Centre for International Forestry Research, Indonesia Provincial Development Planning Board for East Nusa Tenggara, Indonesia University of Gajah Mada, Indonesia
Project Budget	$774,664
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Mrs Heather Crompton

Project background and objectives

This project arose from the need to develop relevant policies and policy outcomes, communication and education products that will facilitate and enable the judicious use of fire in sustainable land and forest management. The scientists are determining current and past patterns of fire in a range of strategically located sites in western Indonesia (southern Sumatra, East Kalimantan), eastern Indonesia (Sumba and Flores) and northern Australia. They are reviewing national, state/regional policy frameworks regarding underlying fire management issues and past/current impacts of these policies, and determining positive and negative impacts of a range of fire management strategies, particularly for forestry. Finally they are employing participatory planning methods to determine appropriate fire management strategies, identify policies that facilitate improved livelihood options for different land-uses and enhance land and forest management capacity of stakeholders and associated institutions.

Project progress

Year 1 (01/07/2002–30/06/2003)

The project commenced in November 2002. Project staff members have been recruited in northern Australia and eastern Indonesia. During November and December 2002 field sites were selected on Sumba and Flores, and initial ground truthing of satellite imagery was carried out. A website was established for the project (http://fireindon.ntu.edu.au).

At the inception meeting for the project held in Waingapu, Sumba, in March 2003 official support for the project was pledged by representatives of the BAPPEDA NTT and the Bupati of East Sumba Regency. Project researchers described fire mapping work in northern Australia and its application to land management. They also discussed the physical, economic and social characteristics of the eastern Indonesian field sites, including current and past fire patterns. Members of the CIFOR team described their projects in western Indonesia that will complement the eastern Indonesian work. The methodologies to be used in the project were refined at, and following, the inception meeting. The meeting's participants, including BAPPEDA officers, visited the field sites.

In western Indonesia, there are study sites in the Middle Mahakam area and Southern Sumatra. Landsat images from 1987 to 2001 have been used to map land cover change. Fire maps have been constructed using hotspot data. Land use, land tenure and soil types have also been mapped.

In eastern Indonesia, satellite imagery and maps for the study sites have been obtained. Training for the NTT project team included the use of image-processing software, and geographic positioning

system (GPS) equipment, with a high degree of accuracy achieved in locating weigh points on the topographic maps of the area. The NTT geographic information system (GIS) officers have received training in methods for participatory mapping, ground truthing imagery and processing of satellite imagery.

Field sites have been established at Kiri Tana and Luku Wingu, near Waingapu, Sumba, and at Dhereisa and Dorameli near Bajawa, Flores. Participatory mapping has begun at these sites. Current satellite imagery has been used to establish land cover maps that will serve as the base level of GIS. Hotspot data are being verified as an indicator of current fires. Ground truthing of imagery and hotspot data are underway. Historic imagery and aerial photos are being used to deduce land-use changes and fire history.

Participatory Rural Appraisal work is underway in the study areas of eastern Indonesia. Four focus discussion groups have been established at the study sites. Surveys have been designed to assess the impacts of fire on social, economic and biophysical aspects of the livelihood and environment of the villages in the study areas. Newsletters, reporting progress in the project, have been produced in Sumba and Flores.

FST/2000/123: Heart rots in plantation hardwoods in Indonesia and southeast Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Tasmania, School of Agriculture, Australia
Project Leader	Dr Caroline Mohammed Phone: (03) 6226 2717 or (03) 6226 7954 Email: Caro.Mohammed@utas.edu.au
Collaborating Institutions	Gadjah Mada University, Indonesia Centre for Forest Biotechnology and Tree Improvement, Indonesia Institut Pertanian Bogor, Indonesia Forest and Nature Conservation Research and Development Centre, Indonesia CSIRO Forestry and Forest Products, Australia
Project Budget	$399,556
Project Web Site	http://www.agsci.utas.edu.au/heartrot/index.asp
Project Duration	01/01/2001 to 31/12/2005 (Project extended from 01/01/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

In Indonesia over 700,000 ha of Australian tropical acacias—*A. mangium* in particular—have formed the resource base for large paper industries throughout the country. However severe fungal heart rot that forms in the central core of the stem at an early age has limited utilisation of *A. mangium* and other tropical acacias to short-rotation cropping. This defect does not seriously affect pulping properties if the crop is harvested early but it significantly reduces the recovery of sawn wood and veneer from older logs grown for higher value products. Australian eucalypts are also prone to heart rot which can affect recovery of sawn wood and other higher value products. Much of Australia's 300,000 ha of plantation eucalypts is destined for the pulp and paper market, but it is hoped that at least some of this resource could be managed for sawn wood and veneer. Little is known about the identity and behaviour of the actual causal fungal agents involved with acacias or eucalypts. This project is increasing the understanding of the causes and nature of heart rot incidence in acacias in Indonesia and Australia, and in eucalypts in Australia, leading to reduced tree losses and increased opportunities for value-added products.

Project progress

Year 3 (01/01/2003-31/12/2004)

Heart rot incidence of *Acacia mangium* in Indonesia

The project team devised a new and rapid survey method for heart rot and conducted surveys in major plantation areas (three regions of Sumatra, West Java and East Kalimantan). Heart rot incidence varied from 6.7% in East Kalimantan to 46.7% in West Java. Variation in heart rot incidence throughout Indonesia is probably due to a complex of climate, past vegetation, seedlot and management practice. These factors, such as seedlot and pruning and thinning management practices were further investigated.

Heart rot incidence differs with seedlot of *A. mangium.* A provenance trial was conducted in South Sumatra to determine if there is any within-species variation in heart rot susceptibility. Some similarities were detected in trends for heart rot incidence according to seedlot from the two different trials. This information provides practical options for reducing heart rot in plantations grown for solid timber by selecting the seedlots associated with least heart rot.

Polyphenols contribute to heart rot susceptibility or resistance

Wood properties explaining why *A. mangium* is generally susceptible to heart rot have been assessed and extractives are an important factor. Analysis of *Acacia mangium* and *A. auriculiformis* (classed as resistant to heart rot) heartwood extracts has provided a potential basis to determine heart rot susceptibility or resistance. At certain concentrations, selected compounds appear to inhibit the action of fungal laccase and quench the radical reactions required for wood degradation.

Pruning and singling in plantation

To investigate the role of singling and pruning on heart rot incidence, the project team conducted a pruning trial including form pruning and standard pruning. Eighteen months after the pruning, the team harvested 54 trees and assessed every branch internally for heart rot. Surprisingly, heart rot incidence was negligible at the site chosen and therefore it was not possible to make any judgements about the effectiveness of the different treatments. However, the effect of the treatments on growth and form was assessed and form pruning is advised as a method to reduce branch size and correct tree form. Pruning guidelines have been developed and may be adopted by industry.

Root rot in *Acacia mangium*

Root rot of *Acacia mangium* caused by *Ganoderma* spp. is a serious concern to industry in Indonesia. The project team surveyed root rot incidence and spatial arrangement in commercial plantations and trials. In second-rotation commercial plantations in two regions of Sumatra and one in Kalimantan, root rot incidence was recorded between 3 and 28%. The compartments surveyed in Riau province and East Kalimantan had significantly higher root rot than South Sumatra. This result seems most closely related to vegetation history of the sites, as the South Sumatra sites are ex-grassland while the other two are ex-forest.

Fruit bodies of *G. philippi* and other species were collected in all regions. In a provenance/family trial of *A. mangium* in Java, root rot incidence was surveyed twice, and found to be around 7% at the first survey and 13% during the second survey one year later. Analysis showed that infected trees were randomly distributed at the first time point but more aggregated by the time of the second survey. This highlights the probability of vegetative spread of the fungus after initial introduction to the site.

Identifying fungi responsible for heart rot and root rot

Collections of 90 fungal fruit bodies were made in plantations and isolates from 172 cultures of heart rot fungi were taken from wood samples. The fruit bodies were identified and analysed with molecular methods to establish a reference collection for identifying heart rot isolates associated with no fruit body. *Ganoderma phillippi* fruit bodies were matched using molecular techniques to rotted roots of dead trees, giving unequivocal proof for the first time that this fungus is a major cause of root rot.

Australian-based research on eucalypt stem decay

A trial at three Tasmanian plantations of *Eucalyptus nitens* produced data that confirmed it is possible to monitor the spread of decay in pruned plantation-grown *E. nitens* and to predict more accurately the impact of decay on harvest yields of solid-wood products.

PHT/1997/017: Reducing aflatoxin in peanuts using agronomic management and bio-control strategies in Indonesia and Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Graeme Wright Phone: (07) 4160 0734 Fax: (07) 4162 3238 Email: graeme.wright@dpi.qld.gov.au
Collaborating Institutions	Research Institute for Legumes and Tuber Crops, Indonesia Assessment Institute for Agricultural Technology, Indonesia Gadjah Mada University, Indonesia University of Sydney, Australia SEAMEO Regional Centre for Tropical Biology, Indonesia
Project Budget	$715,741
Project Duration	01/07/2001 to 30/06/2004
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Aflatoxin is a human carcinogen that contaminates peanuts and hence is a major food quality problem throughout the world. The human impact of aflatoxin in developing countries such as Indonesia, Philippines and Vietnam is enormous, and is estimated to cause more than 20,000 deaths per annum. In Australia, aflatoxin has been a problem for the peanut industry for nearly 20 years, but only recently has it become a major food safety issue for the entire industry.

Several ACIAR projects have addressed aspects of aflatoxin assessment, and integrated control strategies are now emerging. The broad aim of this project is to minimise, and eventually eliminate, aflatoxin contamination in Indonesian and Australian peanuts through research, development and extension of appropriate on-farm and post-harvest management practices. It builds on the earlier research and other work on drought tolerance (a trait that was found to reduce contaminant risk).

Advances in agronomic management of aflatoxin since the earlier projects mean that reduced risk of aflatoxin contamination in peanuts, including through the use of drought-resistant peanut cultivars, is now feasible. This project is establishing the extent and relative importance of pre- and postharvest aflatoxin contamination in peanuts, and developing biocontrol, management and crop/fungus modelling strategies to minimise the impact of aflatoxins in both Indonesian and Australian cropping systems. Scientists are evaluating a number of crop management and varietal methods to control 'on-farm' aflatoxin contamination. As well, a simulation modelling approach integrating the interaction between *Aspergillus flavus* and its environment is assisting assessment of the probability of aflatoxin formation at various stages during growth, harvest and storage of peanuts.

Project progress

Year 2 (01/07/2002–30/06/2003)

Strategic surveys of peanut products conducted in Central Java have shown that alarming levels of *Aspergillus flavus* infection and aflatoxin contamination are occurring in raw peanut kernels collected from retailers in traditional markets. These raw kernels had up to 100% infection with *Aspergillus flavus,* and aflatoxin contamination in the range of 2 to 340 parts per billion (ppb). In contrast, peanut samples collected from farmer's fields, *penebas,* processors and collectors were generally low in *A. flavus* infection, and had low aflatoxin contamination (< 15 ppb). Results from the survey clearly indicate that postharvest handling methods employed prior to peanuts being delivered to retailers, and especially at the retailer level in traditional markets, will severely impact on the level of aflatoxin

contamination in peanuts in the Indonesian food chain. Any future efforts to reduce or eliminate contamination must necessarily target postharvest handling in the initial stages, as this would have the greatest impact on overall reduction of contamination.

Field and on-farm management and variety trials were conducted during the 2002 dry season (July–November 2002) in eastern Java (RILET) and central Java (GMU) sites. In general these trials have shown there is very little pre-harvest aflatoxin occurring under field conditions in Indonesia, despite the presence of quite severe end-of-season drought conditions and high soil temperatures. In Australia, the aflatoxin minimisation program being implemented via a harvesting management decision-support package has had a significant impact on reducing on-farm aflatoxin for dryland peanut growers. During the 2001–02 season drought and high soil temperatures during the pod-filling period meant aflatoxin risk was extremely high (i.e. 100% risk according to the QDPI aflatoxin risk model), yet growers who implemented the minimisation strategy (i.e. early harvesting, short cutting–-threshing intervals, pre-cleaning, inverted windrows, rapid drying to safe moisture (12%) were able to minimise positive loads deliveries to around 40%, compared to the regional average of nearly 65% positive.

The aflatoxin module has been successfully incorporated into the APSIM peanut model, and assessed under Indonesian conditions. A range of medium- to long-term climate data for a number of peanut growing sites throughout Java has been accessed via the web and also from the Indonesian meteorological bureau. Project scientists have begun to determine regional aflatoxin risk for peanuts throughout Java using a newly developed software tool called 'Peanut Whopper Cropper', which allows users (i.e. researchers, industry personnel, policy makers etc) to select peanut cropping scenarios (e.g. location, time of planting, variety, irrigation etc) and assess the associated aflatoxin risk (in terms of probability of exceedance).

Project surveys have confirmed that peanuts are highly contaminated with aflatoxin posing a severe health threat to Indonesians. Many supply-chain members have a poor understanding of the significance of the incidence, health effects and minimisation of aflatoxin. Perhaps fortunately, the main source of contamination identified in Indonesian surveys is in post-harvest, post-farm gate handling. As a result any attempt to rectify the problem efficiently would be best directed at this sector, making the logistics of developing a management package and subsequent extension efforts considerably easier and more practical than at first recognised.

In early 2002, each of the three collaborating institutes were provided with all essential equipment, immunoreagents and an aflatoxin standard needed to conduct the SUNQuik Aflatoxin Test. Significant training activities were also conducted during Year 2, including a workshop at the SEAMEO BIOTROP Institute, Bogor, titled *Analysis of Aflatoxin B1 in Peanuts.* This workshop sought to provide quality control for ELISA analyses for aflatoxin B1. Close linkages were also made with DFID (UK) project on transfer of technology related to aflatoxin kit production with BALITVET in Bogor.

PHT/2000/102: Selection for improved quality and resistance to *Phytophthora* pod rot, cocoa pod borer and vascular-streak dieback in cocoa in Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	La Trobe University, Australia
Project Leader	Dr Phil Keane Phone: (03) 9479 2219 Email : p.keane@latrobe.edu.au
Collaborating Institutions	Master Foods Pty Ltd, Australia Assessment Institute for Agricultural Technology, Indonesia University of Sydney, Australia Research Institute for Estate Crops, Indonesia Dinas Perkebunan, Indonesia Indonesian Coffee and Cocoa Research Institute, Indonesia PT Effem (Mars Inc), Indonesia University of Queensland, Australia
Project Budget	$399,881
Project Duration	01/01/2001 to 31/12/2006 (Project extended from 01/01/2004 to 31/12/2006)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

This medium sized project aims to reduce disease and pest loss threats in the Indonesian cocoa industry. Vascular-streak dieback (VSD), *Phytophthora* pod rot (PPR) and *Phytophthora* canker are the main diseases of cocoa in Indonesia, while cocoa pod borer (CPB) is a very serious insect pest that is gradually spreading through the main cocoa growing areas in Indonesia's eastern islands and is a quarantine threat to Papua and Papua New Guinea. The project is enhancing the infrastructure and capability within Indonesia for the collection, maintenance and screening for pest and disease resistance of cocoa genotypes, and conducting preliminary collection and screening of material and assessments of quality characteristics. It will deliver benefits to cocoa smallholders in south and southeast Sulawesi. A particular opportunity exists for strengthening the links between BPTP, ICCRI and Mars Inc. through Mars' research and processing facility.

Project progress

Year 3 (01/01/2003–31/12/2003)

Indonesian project members have endeavoured to continue the establishment and maintenance of the field trials at Soppeng and Ladongi. Progress has been slow, especially at Soppeng, because of difficulties in getting the farmers on whose trees the test clones have been grafted to follow advice about pruning of the mother trees to allow full establishment of the grafts.

The July 2003 review highlighted the progress made in the project in (i) forming linkages between ICCRI, BRIEC, BPTP Kendari, PT Effem and the SUCCESS Project in Indonesia, and between Indonesian scientists and their counterparts in PNG, (ii) training and giving experience to two younger scientists from BPTP and a young cocoa breeder from ICCRI, (iii) establishing collections of 30 local and 30 international cocoa clones ready for screening for resistance and quality, and (iv) developing methods for on-farm selection and screening of improved cocoa types. Reviewers noted the difficulty encountered in developing fully replicated and established screening trials on farms.

Progress on increasing the number of replicate grafts in the Soppeng trial has been slow (only 95 new grafts have been made over the last 6 months); 30 out of the total of 48 clones in the collection at this site still need further replicate grafts to reach the required number of 10 replicates. Farmers involved

in these trials are reluctant to conduct vigorous pruning of the mother tree to allow full establishment of the grafts. As long as the grafts get established as extra branches on the mother trees, they may still produce enough pods to allow some of the assessments that we have planned. In December 2003, a farmer cooperator conducted severe pruning of 50 trees he has side grafted on his farm. It is hoped that this may be a good demonstration to the other farmers that side grafting and pruning will result in a productive new tree, thus pushing them to allow the full establishment of the genotypes on their farms. VSD was found to be quite common at Soppeng and the scientist took some infected twigs back to BRIEC to isolate the fungus.

Progress in the trial at Ladongi has been more positive. During the last 6 months of 2003, 160 successful grafts were made, to bring to 28 the number of clones with at least 10 replicates (leaving 20 clones still needing further grafting). Local partners are now skilled at doing the grafting, although the follow-up careful removal of the bags and nursing of the grafts is still a problem because they visit the trials only monthly. One farmer cooperator has now been shown how to nurse the grafts and hopefully this will facilitate the complete establishment of that trial. Also, local Dinas Perkebunan staff will help with the follow-up work. The two participating farmers at Ladongi are prepared to do the heavy required pruning of the mother trees.

The third trunk injections for the phosphonate trials in Soppeng and Ladongi were done in July 2003 and results of harvests have been collated.

SMCN/1999/005: Improved soil management on rainfed vertisols in Nusa Tenggara

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	La Trobe University, Department of Agricultural Sciences, Australia
Project Leader	Dr Judy Tidsall Phone: (03) 94793561 Email : J.Tidsall@latrobe.edu.au
Collaborating Institutions	University of Mataram, Indonesia
Project Budget	$398,375
Project Duration	01/01/2001 to 28/02/2005 (Project extended from 01/09/2003 to 28/02/2005)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

This project is seeking alternatives to the existing tillage system (gogorancah) used in Lombok where there are heavy clay soils (vertisols). The current system relies on heavy tillage, which is strenuous time-consuming labour. Reducing this tillage, by using permanent raised beds and increasing the organic matter in the soil, is likely to improve productivity. The project is testing these ideas and refining alternative systems for farmers in affected parts of Indonesia, as well as tomato growers using vertisols in Australia.

Project progress

Year 3 (01/01/2003–31/12/2003)

Demonstration in the field that on permanent raised beds crop yields increase, and soil friability and organic matter concentrations improve

The yield of rice as the first crop on permanent raised beds was 90% (Wakan) and 92% (Kawo) that on flooded flat land. This was partly due to fewer plants, i.e. furrows used land that could have been occupied by plants. Yields may be better on narrower raised beds. Plants on outer rows on raised beds probably received more light, so produced heavier individual grains of rice, than did plants on middle rows. The rice variety Widas produced higher yields than did Tukad Bulian. At each site, there were no differences in soybean yield as a secondary crop between treatments. The heavier seeds and more seeds/plant on permanent raised beds resulted in yields that more than compensated for growing fewer plants than on flat land.

In 2003, the soil at each site had slumped to 14 cm height, and drainage was poor, especially during heavy rain. Hence in October 2003, the beds were renovated to a height of 40 cm. The soil at Wakan, but not at Kawo, was more stable in wavy beds, probably because beds were waterlogged for less time, than was soil in other raised beds or on flat land. When the soil surface was dry, after the secondary crops, the cracks on raised beds were narrower (possibly becoming more self-mulching) than those on flat land.

Production of more profitable crops, including vegetables, on vertisols

Onion was not reliable grown in the rainy season, and farmers are not interested in growing crops other than rice in the rainy season. The most profitable secondary crops were chilli grown on permanent raised beds followed by intercropped tomato/mungbean. The advantage for farmers is that chilli from this region is sold about one month (at Rp. 5000 per kg) before that sold (at Rp. 1000 per kg) from other regions on Lombok. Labour for hand-weeding is the big expense on permanent raised beds, so further research is needed on weed control. It is also costly to bury fertiliser on the raised beds, so in 2003–2004 scientists applied fertiliser soon after rain, to ensure access by plants.

Increase in the supply of water for secondary crops

More water was harvested from permanent raised beds than from flat land. This harvested water could be used to irrigate a larger area under secondary crops than farmers do at present. Scientists are testing the feasibility of growing a tertiary crop with deep roots that could use water stored deep in the profile.

Determination of mechanisms by which vertisols a) become massive under gogorancah, and b) become soft and friable under unflooded permanent raised beds and minimum tillage

Several laboratory experiments showed that exchangeable cations appear to stabilise aggregates more in nil self-mulching soils (as on Lombok) than in two self-mulching soils from Australia. In the Lombok soils, organic matter appeared to be a better stabiliser than were exchangeable cations. The opposite was the case in a moderate self-mulching soil from Australia. Several cycles of wetting and drying, a possible method of weed control, increased the stability of the air-dried soils from Lombok, but did not affect the stability of the self-mulching soils from Australia. In a field experiment on flat land at Gnarwarre, Australia, a heavy clay soil susceptible to waterlogging was more stable after four years of pasture than after continued crops of wheat or in fallow. Sand mixed with the surface soil improved establishment of wheat.

SMCN/2002/033: Seasonal climate forecasting for better irrigation system management in Lombok

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Agency for Food and Fibre Sciences, Australia
Project Leader	Yahya Abawi Phone: (07) 4688 1123 Email : yahya.abawi@dpi.qld.gov.au
Collaborating Institutions	University of Mataram, Indonesia Department of Natural Resources and Mines, Queensland, Australia Regional Infrastructures and Settlement Agency, Indonesia Bureau of Meteorology and Geophysics, Indonesia
Project Budget	$713,504
Project Duration	01/01/2004 to 31/12/2007
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Crop production in Lombok, dominated by rice farming, is dependent on diverting water form rainfed streams. Previous research (LWR2/1996/215) showed that rainfall patterns in Lombok for September to December have suitably high levels of predictability. Utilising seasonal forecasting, historical trends and modelling is helping to predict rainfall patterns, leading to enhanced planning options for cropping and irrigation flows. Feeding this information into existing decision support systems aims to provide a range of benefits: the refining of these support systems, simulation of forecasting benefits to economic outputs and income distribution, promotion of forecast-based planning and the building of local capacity in forecasting and decision support tools.

Project progress

First progress report due in early 2005.

ADP/2001/105: Can decentralisation work for forests and the poor? Policy research to promote sustainable forest management, equitable economic development, and secure local livelihoods in Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Centre for International Forestry Research, Forests and Governance Programme, Indonesia
Project Leader	Dr Eva Wollenberg Phone: +62 251 622 622 Email : e.wollenberg@cgiar.org
Collaborating Institutions	Murdoch University, Australia Center for the Study of Law and Regional Autonomy, Indonesia Tanjungpura University, Indonesia University of Hassanudin, Indonesia University of Papua, Indonesia Yayasan Pioner, Indonesia
Project Budget	$440,753
Project Duration	01/01/2003 to 30/09/2004
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Laws enacted in Indonesia in 1999 aimed to decentralise administrative and regulatory authority over large segments of the country's economy, including the forestry sector. But poor coordination between the different levels of government, lack of clarity of new regulations, inadequate preparation and little institutional capacity to deal with the new responsibilities in district agencies have all impeded the decentralisation process. This project is assisting Indonesia to assess and monitor progress in decentralisation and to implement, where necessary, corrective measures to ensure success of the decentralisation objectives. Researchers are documenting the impacts of decentralisation on forests and forest communities and providing policy makers with timely analyses of these impacts. They are identifying strategic interventions to promote sustainable forest management, equitable development and secure local livelihoods. They are also strengthening policy dialogues and building Indonesia's capacity to carry out policy-responsive research.

Project progress

Year 1 (01/01/2003–31/12/2003)

Key challenges have been identified through CIFOR's ongoing research on decentralisation—supported by ACIAR and DFID (UK) since 1999. These challenges include an urgent need for policy-relevant information on the impacts of decentralisation by stakeholders in the decentralisation process at every level of the of the governance system. Those seeking to promote good governance under decentralisation in the forestry and other sectors share this information requirement.

Decentralisation is commonly advocated as a model that offers opportunities to improve levels of democratic involvement in state governance systems; greater government transparency and accountability; and higher levels of effectiveness and equity in both public service delivery and in the allocation and management of economic and environmental resources. However, devolving decision-making to lower levels of government does not in itself guarantee improved public participation in decision-making; nor does it guarantee increased effectiveness and equity.

The networks of groups and individuals who influence forestry decision-making do not necessarily represent a well-informed, balanced and representative forum for decision-making. Such a forum

requires that final outcomes are informed by the needs and aspirations of the citizens who will be most affected by them; and supported by freely available and accurate information. Another challenge identified by CIFOR is the need to improve processes and techniques for meeting information requirements and including the needs and interests of a wider cross-section of society in current decision-making processes.

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

Overseas Collaborating Countries	Indonesia, Vietnam
Commissioned Organisation	International Potato Centre, Vietnam
Project Leader	Dr Dai Peters (c/- CIP Headquarters, Lima, Peru) Phone: +51 1349 6017 Email: d.peters@cgiar.org
Collaborating Institutions	Balai Penelitian Tanaman Kachang-Kachangan dan Umbi-Umbian (Balitkabi), Indonesia National Institute of Animal Husbandry, Vietnam South Australian Research and Development Institute, Australia Food Crop Research Institute Dinas Peternakan, 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

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

Project progress

Year 3 (01/01/2003–31/12/2003)

Key findings from the village social, population and activity survey

Analysis of the village social, population and activity survey was completed and some of the key points include:

- Women and girls allocate more time for work than men and boys.
- Sweet potato (SP) planting and harvesting is the most labour-intensive activity and is mainly done by women.
- SP as human food is steadily declining, but its significance as pig feed is increasing.
- The number of pigs owned determines a woman's position in the *sili* (family compound).
- Observation of sows in selected villages confirmed that sows farrowed 1.1 litters/year with an average of 5.9 pigs/litter.

Results of the sweet potato experiments and adoption surveys

- Seven new clones have been bred and selected for pig and human consumption. Criteria included yield, protein content and taste.

- The major SP activity will be a series of multi-location trials to enable the new varieties to be registered for release to farmers.

Results of the nutrition experiments and the diet development

- Production baselines (growth rate and mortality) were established in observational experiments in two villages. Under current husbandry, health and feeding management systems average daily gain (ADG) ranged from zero to 30g/day with 40% mortality over a 4-month period. Removing parasites marginally improved ADG to 15–66 g/day.
- A series of diets were tested by feeding them to parasite-free pigs with an initial weight between 10 and 14kg. The Wamena #1 diet—a modified diet consisting of cooked SP vines (56%), cooked SP roots (33%) and cooked banana trunk (11%) with 0.5% salt added, gave the best results with an ADG of 150–200g/day between 10 and 35 kg. Feeding uncooked SP roots and vines achieved growth rates < 100g/day.
- Two other diets are being tested. The Wamena #2 diet—fresh uncooked SP roots (22%) and vines (33%) plus a mixture of fermented SP roots and vines (33%) and cooked banana trunks (11%) and the Wamena #3—the same diet but with cooked SP roots and vines. The fermented mixture contains 85% fresh roots, 15% fresh vines and 0.5% salt fermented for 14 days.
- The farmers have reacted very positively to the new diets, despite the increased labour and time required to prepare them.

Implications of disease survey

Analysing the implications of the disease survey undertaken in October 2002 has been completed.

- Most pigs examined were in poor condition with minimum fat reserves, indicating malnutrition.
- Blood tests confirmed freedom from *Mycoplasma hyopneumoniae*, transmissible gastroenteritis, brucellosis, leptospirosis, porcine parvovirus and classical swine fever. However, pigs were sero-positive for Aujezsky's disease, toxoplasmosis and trichinellosis.
- The most significant health problems identified were internal parasites, found in the stomach, intestines, lung and kidney, and ingestion of pyrrolizidine alkaloids from plants.

Results of husbandry and management experiments

- During the socio-economic survey it was discovered that traditionally pigs were housed in pens inside houses overnight, and allowed to forage in restricted fenced areas called lalekens, during the day. The confined areas were not planted with pasture and any vegetation was confined to weeds and woody plants. Currently pigs are allowed to free-range during the day, which gives them access to toxic plants and results in crop and environmental damage. When not free-ranging they are confined in a compound where children play and hence they have access to both dog and human faeces.
- Much effort has already gone into developing a modified laleken system that incorporates rotational foraging of high-protein pastures and dunging areas. The aim is to improve dietary intake, improve parasite control and prevent pigs having access to toxic plants. Confining pigs in lalekens will also have human health and environmental benefits.
- Preliminary experiments indicate that there will be positive benefits in both nutrition and parasite control resulting in increased growth rates and a reduction in the time pigs take to reach a sale weight.

A number of training initiatives have already been completed at village level, including a series of workshops for training farmers in feeding and managing pigs. At the request of farmers, a series of simple post mortem workshops were held in eight villages with an average attendance of 36 farmers at each workshop. Farmers were shown how to open a pig and examine it for parasites and common lesions, as well as how to check pigs being slaughtered for human consumption for parasites and septicaemia. A manual containing a set of photographs is being translated into Bahasa for distribution.

FST/1999/035: The impact of changing agroforestry mosaics on catchment water yield and quality in Southeast Asia

Overseas Collaborating Countries	Indonesia, Thailand
Commissioned Organisation	World Agroforestry Centre, South East Asian Regional Research Program, Indonesia
Project Leader	Dr Meine van Noordwijk Phone: +62 254 1625 415 Email : m.van-noordwijk@cgiar.org
Collaborating Institutions	Bogor Agricultural University, Indonesia CSIRO Land and Water, Australia Chiang Mai University, Thailand Lampung University, Indonesia Forest and Nature Conservation Research and Development Centre, Indonesia Australian National University, Australia Center for Soil and Agroclimate Research, Indonesia Brawijaya University, Indonesia National University of Singapore, Singapore
Project Budget	$1,142,952
Project Duration	01/07/2002 to 30/06/2006
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

In many developing countries scarcity of land has produced a steady migration of settlers to farm forested uplands. These settlers have come into serious conflict with downstream water users (irrigation, industry and urban) because of real or perceived impressions of lower quality water and reduced flows from catchments. The response of most governments has been to restrict agriculture in critical catchments and/or to evict farmers, at considerable economic and social cost. The aims of this project are to characterise current land-use, look for trends in land-use change in selected watersheds, and determine how changes (including seasonal changes) affect filter functions and impact on water quantity and sediment load. The scientists are testing the effectiveness of existing filter elements, incorporating the data into spatially explicit models of soil and water movements in landscape mosaics at catchment scale, and quantifying the trade-off between watershed functions and profitability of land-use for current and possible future land-use mosaics. There is also some participatory exploration of alternative practices.

Project progress

Year 1 (01/07/2002–30/06/2003)

In the first year the project team made substantial progress towards each of the three project goals for the major research sites in Sumberjaya (Lampung, Indonesia) and Mae Chaem (northern Thailand):

Analysis of historical records of rainfall and river flow revealed a) the differences and similarities between the two study catchments, and b) the relative importance of changes in tree cover for total water yield (especially at 1.5 m of rain per annum in northern Thailand) and of changes in soil properties for the quick flow component (especially at 2.5 m of rain per annum in Lampung). To bridge between plot-level data and landscape level effects, a spatially explicit rainfall simulator proved to be an essential tool. Analysis of available data showed the low spatial correlation in rainfall events in the Sumberjaya watershed if distances between recording stations are larger than 2–3 km.

Uncertainty on total input of rainfall is a major constraint to the validation of models with the scarce data sets available. Project members have to rely on a comparison of statistical distributions, rather than event-level correspondence between observed and predicted flows. Quantitative tests of the models for both catchments show satisfactory correspondence on indicators of total water yield, buffering of flow and dry-season flows. The land use change in the period 1975 (still 60% forest) to

2000 (15% forest) in Sumberjaya has increased the total water yield per unit rainfall (from 45 to 70%) as well as the number of days that the target water flow for the hydroelectric facility can be met. A new 'buffer indicator' that relates peak flows to peak rain events showed a parallel shift, but there was no consistent change in either the river volume in the driest month or the maximum daily flow.

Equipment was obtained and installed to monitor sediment loads of the river in two subcatchments of Sumberjaya. Initial results of monitoring water quality identified limited problems with sediment loads but valid concerns about pesticide levels linked to pockets of intensive horticulture, in both Mae Chaem and Sumberjaya. A lot of the riparian vegetation just next to the river—albeit often a very narrow strip—is still intact, stimulating biological life. Model analysis suggested that the riparian zone forest has a more-than-proportionately positive impact on reducing sediment loads of the river, provided that there are no 'break-through' points where footpaths, motorbike trails or roads intercept streams and rivers.

The first agreements were signed between local government and farmer groups in Sumberjaya under the 'community forest management' (HKM) umbrella to allow multistrata coffee gardens to be maintained within the 'protection forest' zone, provided watershed functions are maintained. The project research contributes to the development of criteria and indicators for such agreements and the way they can be monitored.

With the low current prices of coffee the profitability of coffee-based systems has dropped to a level that the opportunity cost of labour is too high for intensive management. Mixed tree-based systems are superior to intensive coffee monocultures when long-term price estimates are used. With improved road access to the area the option of intensive horticulture is gaining popularity, although it only covers a small fraction of the land in Sumberjaya so far. By contrast intensive horticulture is a major source of income in the Mae Chaem watershed, especially by the Hmong farmers using the ridge tops. Its impact on the soil and on infiltration, as well as on river flow due to dry-season irrigation, is a major reason for concern.

FST/2001/020: Alternatives to slash-and-burn in Southeast Asia, phase 3: Facilitating development of agroforestry systems

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	World Agroforestry Centre, South East Asian Regional Research Program, Indonesia
Project Leader	Dr Meine van Noordwijk Phone : 62 254 1625415 Email : m.van-noordwijk@cgiar.org
Collaborating Institutions	Queensland Horticulture Institute, Australia Lampung University, Indonesia Forest and Nature Conservation Research and Development Centre, Indonesia Center for Soil and Agroclimate Research, Indonesia Indonesian Agency for Agricultural Research and Development, Indonesia
Project Budget	$301,900
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

This project is a phase of the global Alternatives to Slash-and-Burn (ASB) program, a system-wide initiative for which ICRAF is the convening institution and coordinator, and builds on two earlier phases. The broader aim of ASB is to identify and test innovations that will help eradicate poverty while simultaneously curbing the environmental problems associated with deforestation. The current project focuses on agroforestry options for landholders at the farm level to reduce soil loss and enhance water quality through enhanced landscape filter function using trees and other vegetation management. The emphasis is on working with farmers to understand their needs and constraints, and jointly developing and testing options that might ensure environmental improvement while maintaining profitability and viability of farming practices. A longer term goal is to build community groups than can further develop and refine local conservation measures. This research is being carried out in Sumatra within the study area of previous ASB phases.

Project progress

Year 2 (01/01/2002–31/12/2002)

Project results during this year showed that conversion of forest to coffee-based systems had a significant impact on soil chemical and physical properties. In the early stages of establishment of coffee plantations the sites were predictably more prone to soil loss through erosion, although the extent of loss varied considerably with soil type. As the coffee canopy develops soil loss is greatly reduced, but different soil structures give rise to different patterns of soil loss. In Laksana and Tepus sub-villages annual soil loss was less than 3 tonnes per hectare per annum but in Bodong village losses were more than 20 tonnes per hectare per annum both under a 3-year-old sun (monoculture) coffee system. Differences were attributable to different soil macroporosity between the two sites.

One year later, in the rainy season of 2002–03, when the tree canopy cover had increased to about 80%, soil loss was almost undetected in Tepus and Laksana. This suggests that coffee alone once established is an effective soil erosion control, although there is a need to address soil loss in the early stages of establishment. Additional conservation efforts need to concentrate on less porous, erosion-prone soils.

Artificial fertilisers were found to have marked effects on canopy development and consequent soil protection. Fertilization with 450 kg urea, 300 kg of SP-36, and 300 kg of KCl per ha in years 3 and 4 after planting, in contrast to irregular and much lower fertilization under farmer management, has increased canopy cover from 20 to 80%. Yields of coffee bean increased from 168 to 1355 kg per ha,

with a benefit/cost ratio increase from 0.22 to 2.6. Although these effects were confounded with coffee age yields, canopy covers within these experimental plots were from 2–4 times higher than those under farmer management outside the plots, suggesting that increased fertilizer application could bring environmental as well as economic benefits.

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

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

Project background and objectives

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

Project progress

Year 4 (01/07/2002–30/06/2003)

Simulation models are unable to simulate the more complex pattern of N release that has been reported for some animal manures, notably materials that exhibit initial immobilisation of N even when the carbon:nitrogen ratio of the material suggests it should mineralise N. The APSIM SoilN module was modified so that the three pools that constitute added organic matter could be specified in terms of both the fraction of carbon in each pool and also their C:N ratios (previously it has been assumed that all pools have the same C:N ratio). The revised Manure module is better able to simulate the general patterns on N mineralised that has been reported for different quality manures.

A similar approach was taken for the release of plant-available P from organic inputs, so that P release can also be specified in terms of the C:P ratios of the three pools. Appropriate changes were made to the APSIM SoilP module.

The APSIM Maize module was modified so that uptake of P and its partitioning within the crop reflected P availability in the soil, and crop growth was influenced by the P status of the plant. This ‘P-aware’ maize module was a major breakthrough in project team thinking of how to explicitly reflect

P dynamics and especially P limitations in crop simulations. Fieldwork has been initiated using funds from other donors to produce the data to parameterise other crop modules, specifically, Cowpea and Millet (funded by IFDC in West Africa), Pigeonpea, Groundnut and Sorghum (funded by DFID in India) and Canola (funded by CSIRO in Australia). The APSIM model now has a unique capability among simulation models in being able to simulate the N and P dynamics from different quality manures, and there is only one other modelling group that is working on soil P routines.

At the end-of-project review workshop, collaborators agreed to follow-up in the following areas:

- Continue fieldwork developing P-aware crop modules.
- Continue use of APSIM in project activities in east and southern Africa.
- Continue to collect a full dataset from the experiments established under this project in Latin America for further Manure and SoilP module testing.

Concluded projects

1 July 2002–30 June 2004

Bilateral

Multilateral

ADP/1994/049: Policy analysis of linkages between Indonesia's agricultural production, trade and environment

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	University of Adelaide, Centre for International Economic Studies, Australia
Project Leader	Professor Kym Anderson Phone: 08 8303-4712 Email: kym.anderson@adelaide.edu.au
Collaborating Institutions	Ministry of Agriculture, Indonesia Australian National University, Australia Centre for Strategic and International Studies, Indonesia
Project Budget	$903,520
Project Duration	01/01/1996 to 31/12/2002 (Project extended from 01/07/1999 to 31/12/2002)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

At the start of this project Indonesia was experiencing rapid growth in its economy and industry. The Government had introduced environmental policies to deal with its highly complex natural environment. The policies were intended to encourage wise use of resources, control of pollution, deforestation and other activities that potentially degrade biological diversity. Funds were available for research to find less damaging technologies.

The Indonesian Government intended that the nation should grow to the point of self-sufficiency in food, at least for rice, and it subsidised farmers for seed, fertilizer, pesticides and water, gave output price incentives, and set tariff barriers where necessary. Agriculture employed about half the workforce, and Indonesian consumers spend most of their money on its products. It contributed about 15% of export earnings.

Indonesian policy, pricing and subsidies must combine with pollution control and property rights as well as with welfare needs. This project arose from the realization that interactions are intricate and policy-makers need a system-wide perspective from which to make decisions.
The project commenced before the Indonesian financial crisis of 1997. Modifications to the project schedule were introduced so that project members could assist the Indonesian Government during the crisis.

This study examined the impacts of specific pricing policies, investments or subsidies on the goal of food self-sufficiency and on other social, environmental and agricultural targets of this rapidly growing economy. It investigated the options open to Indonesian policy-makers as they implement their commitments made to GATT in Uruguay and considered what might be required in the next round of international agreements. It tested ways of integrating Indonesian needs with those of trade groups in the region.

Project outcomes

The course of the project was interrupted by the Indonesian financial crisis that began in 1997. This led to a significant redirection of research effort, and the researchers were in a position to provide input into the important policy debate surrounding this event. For example, the team produced a volume of works addressing the crisis, entitled ‘Indonesian Economic Crisis: Effects on Agriculture and Policy Responses’.

The reviewers considered that the project was very successful in spite of the extremely unfavorable political and social environment in which it had operated. The review report focused largely on the

CGE model, whose quality was considered to be excellent, and the large volume of output (over 80 papers) was noted. The significant capacity building effort was acknowledged and the review recommendations focused on how to continue the life and usefulness of the model and modelling capacity arising from the project.

The reviewers commended the management of the project researchers from Adelaide University, who made several important decisions during the project that led to an improved output. The first was the change in model design when new software for efficiently solving large CGE models became available. This meant significantly more work for them but produced a better product. As well, the decision to refocus some of the modelling effort onto the effects of the crisis was commended by the reviewers.

ADP/2000/100: Contract farming, smallholders, and rural development in East Java, Bali and Lombok

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of New England, School of Agricultural & Resource Economics, Australia
Project Leader	Dr Phillip Simmons Phone: (02) 6773 2314 Email: psimmons@metz.une.au
Collaborating Institutions	Balai Pengkajian Teknologi Pertanian, Karangploso Assessment Institute for Agricultural Technology, Indonesia Bogor Agricultural University, Faculty of Agriculture, Indonesia Brawijaya University, Department of Social Economics, Indonesia Udayana University, Department of Agricultural Economics and Sociology, Indonesia
Project Budget	$399,480
Project Duration	01/01/2001 to 31/03/2004 (Project extended from 01/07/2003 to 31/03/2004)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

This research aimed to examine contract farming arrangements between smallholders and agribusiness firms in Indonesia. Contract farming helps to overcome problems of imperfect markets in developing countries, and has been successfully adopted in Latin America. The agribusiness firms ensure a guaranteed source of supply and reduce transactions costs, while the farmers are given access to input supplies (such as credit, information on new technologies) and guaranteed prices. However, there were concerns that smallfarmers may not appropriate much of the benefit from these arrangements, and this project collected baseline information on the use of contract farming in Indonesia, with particular emphasis on opportunities for smallholders in East Java, Bali and Lombok. Results from the study should have relevance to agribusiness firms and government decision-makers at both local and national levels.

Project outcomes

Lists of commodities under contract in the East Java, Bali and Lombok survey areas were developed and representatives of the agribusiness firms responsible for the contracts interviewed. The types of contracting, the importance of the commodity to farmers and the structure of the industry were examined for each contract as a precursor to selecting the three contracts that would be used in the study. The interviews resulted in development of a classification for farm contracts based on the degrees of vertical and horizontal integration resulting from the contract, market dominance of contracting firms in markets for inputs and outputs in the contracted commodity and whether the agribusiness firm was privately or publicly owned.

All the contracts involved some vertical integration. In the East Java hybrid corn contract Pioneer purchases output, provides inputs, provides and enforces growing guidelines and bears risks of low quality but not of low prices or yields. The Bali contract for seed rice involved less vertical integration, with PT Pertani purchasing output but not providing inputs except for foundation seed and limited extension advice. The firm also provided growing guidelines, but since smallholders had experience in seed rice production these were not critical for contract success. PT Pertani does not bear risks associated with low quality, price or yield. However it does guarantee the market for output.

In Lombok, Nusantara Unggasjaya Mataram purchased output, advanced inputs, had strict growing guidelines and bore risk associated with quality and price but did not cover disease risk. Ranking the

three contracts on the basis of vertical integration, the Lombok contract involved the most integration and the Bali contract the least. From theory, as vertical integration increases in a contract more transaction costs are saved and hence the contract becomes more valuable to its owner, creating both the means and incentives for firms to be generous with farmers when high levels of vertical integration are involved. This partly explains the econometric result that the East Java and Lombok contracts benefited farmers in terms of increased profits while the Bali one did not.

Horizontal integration, while not necessary for contract success, appeared to contribute to it in certain circumstances. Pioneer needed co-operation between growers for technical reasons and negotiating at group level reduced transaction costs of negotiation, extension, financial transfers and contract compliance. PT Pertani did not need horizontal integration (HI) for technical reasons but used HI to reduce transaction costs of negotiation, extension and financial transfers. It could not use HI to achieve contract compliance since individual contractors could be 'kicked out' of the contract without the whole group losing their contracts as would occur for technical reasons in the East Java contract. In the Lombok contract there was virtually no horizontal integration except for firm representatives addressing informal meetings of broiler growers for extension purposes. Contracts requiring group cooperation for technical reasons such as preventing genetic pollution between adjacent crops, coordinating village labour or sharing machinery or irrigation water were based on group level negotiation. However, in the Lombok contract where there was no technical basis for cooperation HI did not occur.

All three contracts were successful from the perspective of the agribusiness firms involved, inasmuch as the contracts had each been operating for at least five years and none of them showed any sign of joining the long list of 'failed' farm contracts in the developing world. The types of benefits experienced by smallholders were consistent with theory and each contract contributed positively to welfare of smallholders participating in them. All three contracts provided some access to credit or inputs and reduced smallholder risk by providing assurances the firm would purchase outputs. From a development perspective, all three contracts reduced absolute poverty. However, given the agribusiness firms in East Java and Bali favoured larger producers, the latter contracts probably increased relative poverty. In contrast, selection favoured smaller farmers in Lombok and probably reduced both absolute and relative poverty.

A theoretical framework for analysis of contract farming was developed to explain why contract farming occurred in some situations and not others, and what types of benefits both agribusiness firms and smallholders were likely to obtain from contracting. Institute Pertanian Bogor conducted a survey of agribusiness firms engaged in contract farming and centred in Jakarta. The results provided a detailed overview of contract farming practices from the perspectives of agribusiness firms.

There are three types of government policy that the Indonesian Government may consider to facilitate contract farming. These are: (i) adjusting the regulatory regime to reduce transaction costs for participants in contracts; (ii) government playing an enabling role to encourage contract farming; (iii) (perhaps the most important policy) is a 'do nothing' policy of not introducing new regulations for Foreign Direct Investment (FDI) and trade that would in fact discourage contract farming. Regulatory adjustments to create a desirable policy environment for contracting include reducing paper work for exporters, reducing certain import and export taxes, removing import restrictions, implementing food-safety standards, replacing crop production taxes with land taxes and deregulating prices in food markets. Removal of specific regulations can also directly facilitate contracting.

The enabling role of government in contract farming may work at two levels: macro and micro. Macro changes would improve the commercial environment in which contracting occurs and would be directed at reducing costs of contracting for all parties. Micro reforms to facilitate contract farming are training, arbitrating disputes, undertaking research and providing extension services relevant to expansion of contracting. Training programs for smallholders in literacy, accounting and cash management may reduce miscommunication in contracts. Research on agricultural production and food processing, already undertaken by the Indonesian Government, may benefit from sharing information about research priorities and issues with agribusiness firms.

ADP/2000/126: Microfinance for agricultural producers in West Nusa Tengara (WNT) Province, Indonesia: Issues and opportunities for a sustainable financial intermediary system

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Queensland, School of Natural and Rural Systems Management, Australia
Project Leader	Dr Shankariah Chamala Phone: (07) 3365 2159 Email: schamala@uqg.uq.edu.au
Collaborating Institutions	University of Mataram, Indonesia Private Bank of Nusa Tengara Barat (Pt. Bank NTB), Indonesia Centre for Agro-Socio Economic Research and Development, Indonesia
Project Budget	$243,477
Project Duration	01/07/2001 to 30/09/2003 (Project extended from 01/07/2003 to 30/09/2003)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

There have been various systems implemented by the Indonesian authorities to deliver financial assistance to the agricultural producers. Recently, government-promoted systems have incorporated group lending, saving services, and involvement of non-government organisations. However, performance of delivery systems is unsatisfactory, due to many social, cultural, economic or political factors or even the design of the delivery system. In other places small-scale financial services have successfully assisted disadvantaged people, and this project will develop an innovative and sustainable microfinance system for the agricultural producers of WNT Province. Researchers identified relevant issues and opportunities for building a sustainable microfinance system, then designed and implemented a pilot scheme in collaboration with a government bank. The project concluded after an assessment of the pilot scheme's effectiveness.

Project outcomes

The main outputs of this were in three forms:

1. *Publications*: In addition to several reports written during the project life, a special issue of Komunitas (2003) Journal of Rural studies was published, focusing on microfinance programs in Indonesia. This journal was circulated to government agencies and Pt. Bank has distributed it to various banks including the Asian Development Bank (ADB) and World Bank, also the Indonesian Department of Finance and Treasury. In addition, three papers were written and presented in national and international conferences. They were: (i) 'Micro finance for agricultural producers in WNT province, Indonesia: Issues and opportunities for a sustainable financial intermediary system'; (ii) 'Why do rural credit programs fail? Is it lack of empowerment or other factors? Lessons learned from Indonesian rural micro finance and development programs'; (iii) 'One-gate approach to sustainable rural microfinance institutions: A learning outcome from ACIAR project in Lombok, Indonesia'. There have been further publications in Lombok Post and other newspapers.
2. *Capacity building*: More than 440 participants (Staff of PT. Bank, government agencies, The University of Mataram and other MFIs and community leaders) attended capacity-building programs.
3. *Generic model development*: A generic 'one-gate' model was developed. Pt. Bank in collaboration with the research team.

Monitoring, Evaluation and Multiplication: The following outcomes have already been achieved:

1. *Institutional and social impacts*: Institutional change in the Pt. Bank is accomplished and they have accepted a one-gate model and developed operational guidelines to work with Micro Finance Institutions (MFIs). The Mataram Municipal Government-Village MFI is called LKK and the PINBUKNTB and GTZ and University of Mataram are developing MFIs and have also adopted a one-gate model. The Mataram Government and project team signed another project called 'Legislative Drafting for Rural Micro Finance' and the first draft of 'Micro Finance Bill for Mataram Municipality' is complete. Pt Bank has been approached by ADB to develop capacity-building programs for MFIs. Social change is noted among the community leaders because the project followed principles of community development such as participatory action and an action learning process to resolve conflicts and develop a MFI.
2. *Environmental impacts*: The project team facilitated capacity building in Batu Kuta village to produce compost from animal waste. This also solved an environmental problem as the waste was finding its way to irrigation canals and causing water pollution.
3. *Economic impacts*: MFI intermediaries linked to the commercial banks can increase savings and credit facilities for the rural community. In one of the villages savings are already mobilized by forming a women group and credit needs are still met by the direct credit programs. One of the bank staff trained in Australia took retirement and started a Cooperative in Lombok, based on Bendigo Community Bank. It has successfully completed one year of operation. The quantitative cost benefit analysis indicated that total benefits from improved access to institutional credits and saving services in just one year with NPV more than $A1 million. The economic benefits will be much larger if the project team can quantify the project's spill-over effects. However, these potential benefits depend on many other factors. The social capital, empowerment and financial education areas need further research to develop sustainable MFIs in rural Indonesia.

AS1/1996/160: Control of fasciolosis in cattle and buffaloes in Indonesia, Philippines and Cambodia

Overseas Collaborating Countries	Indonesia, Cambodia, Philippines
Commissioned Organisation	James Cook University, The Australian Institute of Tropical Veterinary and Animal Science, Australia
Project Leader	Dr Richard Copland Phone: (07) 4781 4838 Email: Richard.Copland@jcu.edu.au
Collaborating Institutions	National Veterinary Diagnostic Laboratory, Cambodia Central Mindanao University, Philippines University of Southern Mindanao, Philippines Research Institute for Veterinary Science, Indonesia
Project Budget	$1,048,341
Project Duration	01/07/1998 to 31/12/2003 (Project extended from 01/07/2003 to 31/12/2003)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

Fasciolosis caused by infection with the liver fluke, *Fasciola gigantica*, is an important disease of cattle and buffaloes in Southeast Asia. This project validated and extended the successful control strategies developed in Indonesia (Project AS1/1999/023) to control liver fluke in Indonesia, Cambodia and the Philippines. The scientists tested the biological control of fasciolosis by using poultry infected with *Echinostoma revolutum,* as *E. revolutum* and *F. gigantica* compete for the same snail as an intermediate host. They also determined the resistance of cattle and buffaloes to fasciolosis and establish a fascioloa control network throughout Southeast Asia.

Project outcomes

All of the objectives of the project were achieved, although extra time may be needed to complete some elements of the project, and for analysis and publication of the results. The overall output of this project has been to demonstrate in the areas involved in the field experiments that the application of a scientifically based fasciolosis control program will alleviate poverty through increased animal production. The wider application (and benefits) of the results of this project will require the publication and dissemination of results, and the institutionalisation of the extension program by the collaborating countries.

The community impact has been to educate animal owners who participated in the research and increase their income from animal production. The project also had a major impact on the capacity of researchers to successfully carry out experimental work. All of the researchers from Asian countries now have English as a second language. As well, some researchers are better skilled in analysing experimental results. The development of language, writing and analytical skills among the research team will be one of the most significant and long-lasting achievements of this project.

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

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

Project background and objectives

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

Project outcomes

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

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

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

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

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

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

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

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

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

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

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

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

AS2/2000/124: Prospects for improved integration of high quality forages in the crop–livestock systems of Sulawesi, Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Sustainable Ecosystems, Australia
Project Leader	Dr Bruce Pengelly Phone: (07) 3214 2348 Email : Bruce.Pengelly@csiro.au
Collaborating Institutions	Assessment Institute for Agricultural Technology, Indonesia
Project Budget	$399,396
Project Duration	01/01/2001 to 30/06/2004 (Project extended from 01/01/2003 to 30/06/2004)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Sulawesi is seen by Indonesia as one of the islands with potential to increase cattle production to meet the strong demand for beef. At present, farmers are unable meet the current demand, let alone future requirements, and cattle numbers are declining as a consequence of the high off-take. Nutrition is the major constraint to increased cattle productivity, and this project addresses two aspects of this constraint—feed supply *per se* and forage quality. This project concentrated on smallholder farmers operating rainfed mixed farming systems of either rice and cattle or estate crops and cattle. In this environment cropping is confined to the wet season, but there is some rainfall in most months. Farming systems with differing agro-ecological potential were compared in South Sulawesi. Reasons why farmers are reluctant to adopt new technological options were also addressed.

Project outcomes

In benchmarking the most relevant farming systems in South and Southeast Sulawesi the researchers built a database of the existing conditions in four villages representing lowland and upland fields. A second database of existing livestock and forage conditions placed emphasis on inappropriate cattle reproduction cycles practiced by farmers and their relationship to feeding problems and the use of cows as draught animals. The researchers also made key findings from climate monitoring and soil characterisation. They also developed an economic model, a livestock model and an integrated analysis tool.

In the development of a systems analysis framework to enable the evaluation of alternative crop-forage-livestock systems, new modules were developed by taking existing crop models (developed with APSIM) for ‘like’ species and adapting them to represent the desired species, i.e. wheat for rice and sugarcane for Napier grass. The development of an APSIM module for Napier grass produced the greatest enhancement effect.

The researchers found that inclusion of mucuna as a dry season crop in lowland fields and inclusion of Napier grass as a backyard species were most favourable in terms of assured feed supply, animal growth rate and income. Eleven grass and 18 legume cultivars were evaluated by trials conducted at Gowa Research Station to determine yield, vigour, persistence, quality and seed production, but no other potentially suitable legumes and grasses were introduced and integrated into existing cropping systems during the project.

There were substantial increases in capacity in the modeling of crop-livestock systems (in this project as well as AS2/2000/125) in both Australia and Indonesia and significant progress towards a functional model based on data collected at the sites in both Sumbawa (AS2/2000/125) and South Sulawesi. This is the first time that such an integrated model has been developed. Reviewers commented that sustaining the research effort and its application as an extension training tool would require commitment within Indonesia to retain capacity in the use, development and general support of the systems model. They recommended that a pathway be identified towards a formal agreement between Indonesian counterpart organisations and the providers of software support for the APSIM

and related programs. The integrated model of crop-livestock systems in the tropics has multiple applications for research, training and extension. Reviewers highlighted the urgent need to clarify which of these roles is the primary objective of the project and to engage end-users at the earliest opportunity. This process was being followed up. Feedback from possible Indonesian users indicated that stand-alone components of the full model could have value in themselves and may be more appropriate as training tools.

AS2/2000/125: Optimising crop-livestock systems in West Nusa Tenggara Province, Indonesia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Sustainable Ecosystems, Australia
Project Leader	Dr Andrew Ash Phone: (07) 3214-2346 Fax: (07) 3214 2346 Email: andrew.ash@csiro.au
Collaborating Institutions	University of Mataram, Indonesia Assessment Institute for Agricultural Technology, Indonesia
Project Budget	$399,791
Project Duration	01/01/2001 to 31/03/2004 (Project extended from 01/01/2004 to 31/03/2004)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

The strong demand for beef in Indonesia has caused herd numbers to decline in many of the eastern islands. Farmers are keen to increase cattle production, particularly as the relative prices of cattle and grains have changed so rapidly, but they face a constant problem of balancing the crop and livestock components of their systems. The feed supply *per se* and the quality of that feed becomes a real problem during the dry season. However, production of forages on-farm to meet that demand has trade-offs against crop production. Conducting conventional field research to explore the variety of options has serious limitations because the significant year-to-year differences in rainfall and its pattern constrain the ability to extrapolate results to other times. Experience in northern Australia has demonstrated the value of generating simulation models that accommodate these constraints and can link the components of the system. This capacity can then enable the development and evaluation of numerous production options, taking account of price differentials and individual farmer circumstances. The CSIRO Sustainable Ecosystems team (CSE), and their collaborators, have such systems in place and have considerable experience in the humid and semi-arid tropics. This project used that experience to address this problem, with livestock added to that system.

Project outcomes

There were substantial increases in capacity in the modeling of crop-livestock systems (in this project as well as AS2/2000/124) in both Australia and Indonesia and significant progress towards a functional model based on data collected at the sites in both Sumbawa and South Sulawesi (AS2/2000/124). This is the first time that such an integrated model has been developed. Reviewers commented that sustaining the research effort and its application as an extension training tool would require commitment within Indonesia to retain capacity in the use, development and general support of the systems model. They recommended that a pathway be identified towards a formal agreement between Indonesian counterpart organizations and the providers of software support for the APSIM and related programs.

The integrated model of crop-livestock systems in the tropics has multiple applications for research, training and extension. Reviewers highlighted the urgent need to clarify which of these roles was the primary objective of the project and to engage end-users at the earliest opportunity. This process was being followed up. Feedback from possible Indonesian users during the review indicated that stand-alone components of the full model could have value in themselves and may be more appropriate as training tools.

AS2/2000/157: Leucaena management in West Timor and Cape York

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	University of Queensland, School of Land and Food, Australia
Project Leader	Dr Max Shelton Phone: (07) 3365 2541 Email: m.shelton@mailbox.uq.edu.au
Collaborating Institutions	Balai Pengkajian Teknologi Pertanian, Indonesia University of Nusa Cendana, Indonesia Central Research Institute for Animal Sciences, Indonesia
Project Budget	$399,879
Project Duration	01/01/2001 to 31/12/2003 (Project extended from 01/01/2003 to 31/12/2003)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

There are several communities in the eastern islands of Indonesia that utilise naturalised strains of tree legume *Leucaena* for crop and livestock production. The naturalised strains are not resistant to attack from a psyllid insect that has been causing significant reductions in leucaena production since it became apparent over 10 years ago. Farmers operating these systems were better off (in terms of household income, education standards, housing and health) than other groups and were seen as models for elsewhere, but their well-being has declined as a consequence of the effects of psyllids. Psyllid-resistant lines of *Leucaena* have been produced in other projects supported by ACIAR and the objective of this project was to introduce these lines into the Amarasi region of West Timor. The project also provided technical support for an Indonesian Government initiative in North Central Timor designed to arrest the decline in cattle numbers in that region.

Project outcomes

Comparisons made between Amarasi and North Central Timor (Timor Tengah Utara—TTU) districts showed striking differences, highlighted by the year-round growth rates of cattle in the two districts. Growth rates ranged between 400 and 600 grams per day for tethered cattle without project intervention in Amarasi and between 100 and 300 g/day for tethered cattle in TTU. Additional interventions could bring the range in Amarasi to between 800 and 1200 g/day, clearly indicating the potential of multipurpose trees (MPTs) and of Bali cattle to grow quickly on a sustainable resource base. The significant finding was that the critical differences were not in the biology of feed or cattle, or the physical characteristics of soil, terrain or rainfall but in the human factors of management and cultural practices. Thus, scaling up of these highly effective technologies, to emulate the successes of Amarasi, will involved engaging a human model of extension or political change. While remaining a researchable issue, new skills will be required. A geographic information system (GIS) has been useful in this respect but is limited when dealing with human factors that may vary over short distances and short periods.

Several varieties of *Leucaena* were tested by the project. the most easily cultivated variety was Tarramba, while the most productive was hybrid KX2 (albeit with remaining challenges for its effective vegetative and seed propagation). Some of these challenges were investigated by the project and some very good results were reported in the propagation of KX2 from cuttings. Studies of water use efficiency in Timor and Queensland produced encouraging results—the pruning of *Leucaena* at the end of the rainy season extends available water and feed availability well into the dry season when feed supply is more critical.

Several species of MPT and strains of *Leucaena* grew well and fattened cattle in smallholder systems in West Timor. These MPTs have potential for many parts of Indonesia and will undergo further research and development with farmers, especially on variety Tarramba and the new hybrid KX2. Reviewers recommended that the Australia—Indonesia team prepare for the release and large-scale adoption of new *Leucaena* varieties.

ASEM/1999/013: Improved marketing of mandarins in East Nusa Tenggara in Indonesia and northern Queensland

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	University of Queensland, School of Natural and Rural Systems Management, Australia
Project Leader	Dr Sherri Wei Phone: 075 460 1026 Email: s.wei@.uq.edu.au
Collaborating Institutions	Queensland Department of Primary Industries, Australia Universitas Nusa Cendana, Indonesia
Project Budget	$149,907
Project Duration	01/01/2000 to 31/12/2002 (Project extended from 01/01/2002 to 31/12/2002)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Regional horticultural farmers in East Nusa Tenggara (NTT) and northern Queensland operate on a small scale and lack a systematic marketing strategy for their products, which are often of poor and inconsistent quality. The Indonesian farmers have additional problems associated with poor infrastructure and lack of investment.

The initial concept of the project was to look at the horticultural industry in the eastern islands with an agenda for poverty relief for subsistence farmers. Later through an in-country feasibility study, the potential benefit of concentrating on the mandarin industry was identified. The rationale is based on the 1998 measures of the Indonesian Agricultural Ministry to support the development of the mandarin in the NTT Province. There are also non-government organisations (NGOs) from the United States and Japan assisting the development of the industry in NTT.

To match the Indonesian component of the project the mandarin industry in the Atherton Tablelands in north Queensland was considered appropriate. The obvious reason is its similarity to land form and climate conditions to the dry tropics of NTT, but other similarities included: family farms instead of corporations; farmers being price takers rather than planners, and being paid an agreed price in cash by traders; farmers working with the next channel member along the supply chain only, having little knowledge about where their products go; both industries being regarded as having a comparative advantage (variety and agronomic conditions in NTT, and timing of supply in the Tablelands); both industries being assisted and promoted by their governments.

The project initially focused on smallholder mandarin farmers in NTT and northern Queensland, but findings of the project may also be applicable to East Timor.

The aim was to assist farmers in NTT and Atherton Tableland Queensland to improve quantity and quality of fruit production, define specific market requirements and pilot test improved marketing strategies for mandarins.

Project outcomes

In Indonesia supply chain issues in production, marketing, transport, micro finance and market information were analysed. The focus group, taste panel and market intercept surveys indicated that Keprok Soe, the major variety of mandarin in NTT, has certain marketing advantages compared to those from other islands of Indonesia. Training materials were translated into Bahasa as teaching references for UNC staff.

The initial assessment was that production could rebound in the coming seasons starting from 2003 if drought problems did not occur again.There was evidence that key farmers involved in the project had

started to think of themselves as marketers and adopted improved cultural skills in a short period of time.

The results of this project were disseminated through publications, radio broadcasts and linkages with other international and Indonesian projects. Future research for the mandarin industry in NTT may focus on further strengthening of production issues to more villages, postharvest handling, farm-level processing of reject mandarins which account for about 25% of total production in the area, and collaborative marketing through existing farm groups.

ASEM/1999/093: The role of carbon sequestration credits in influencing the economic performance of farm forestry systems

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	University of New England, Australia
Project Leader	Dr Oscar Cacho Phone: 02 6773 3215 Email: ocacho@.une.edu.au
Collaborating Institutions	Centre for International Forestry Research, Indonesia Centre for Socio Economic Research on Forestry, Indonesia NSW Agriculture, Australia
Project Budget	$400,000
Project Duration	01/01/2001 to 30/06/2003 (Project extended from 01/01/2003 to 30/06/2003)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Carbon dioxide (CO2) is the main greenhouse gas. The increase of CO2 and other greenhouse gases in the atmosphere is considered likely to cause global warming. While a forest is growing it is a net absorber of carbon through photosynthesis. After harvest, CO2 is released, although the time scale for its release depends on the fate of the harvested products. To help offset CO2 (or equivalent gases) emitted, it is possible to increase the world's absorption of CO2 through forest growth. Carbon that is sequestered in plant tissue in this way is taken out of the atmosphere and diminishes global warming. This fact is the basis of trading in carbon credits, which will allow a country that is a net CO2 emitter to trade with one that is planting forests or refraining from logging a growing forest. Such trading is allowed under the Kyoto Protocol, at prices determined by the market.

The Australian Greenhouse Office has studied the feasibility of a national emissions-trading system to help meet Australia's difficult commitments under the Kyoto Protocol, while the State of New South Wales has been one of the first governments to enact legislation to facilitate carbon-credit exchanges. The carbon credits concept, when globalised, has important implications for development assistance. Countries need to know about the profitability of carbon credit policies, both nationally and at the individual farmer level.

This project was designed to explore the economics of carbon offsets by forestry, for tropical Indonesia and temperate Australia. Given the long time frames involved in carbon sequestration in trees, as well as the release times, a model was the only realistic way to study the entire process.

Long-term models of rubber tree production and carbon cycles in farm forestry systems were available, and some were calibrated for Indonesian conditions. These models were adjusted to specific productions systems in Australia and Indonesia and incorporated into an economic analysis.

The project was designed to determine the most appropriate farm forestry systems for capturing carbon credit payments, and to evaluate the effect of different mechanisms for translating international exchanges of carbon credits into incentives at the level of individual farmers.

Project outcomes

The project achieved its objectives. The outputs of this project could influence the nature of payments for carbon sequestration services in Indonesia and beyond. Some delays did occur as a result of security issues in Indonesia, but these were overcome by various means, largely through electronic communication.

Proposals for carbon sequestration credits have been plagued by difficulties on both the policy and methodological fronts. One of the major issues has been the problem of 'permanence', caused by the fact that carbon sequestration can be reversed, so a unit of carbon sequestered cannot be equated directly to an avoided emission. This project examined the efficiency of alternative accounting

methods that had been proposed to deal with permanence. The main contribution of the project on this front was to bring solid economic analysis to a problem that was generally discussed only in bio-physical terms.

The project also assisted the Ministry of Forestry and the Ministry of Environment in Indonesia to gain an understanding of the Clean Development Mechanism (CDM) of the Kyoto Protocol. This occurred through three means: (i) A member of the Indonesian team was also a participant in a National Strategy Study on land use, land-use change and the forestry sector, under supervision of the Ministry of Environment; (ii) A member of the project also became a member of the CDM Secretariat formed by the Ministry of Forestry, so she was able to communicate results of the research to policy makers; (iii) a workshop on the CDM held at the end of the project attracted government officials and researchers from various organisations in Indonesia and from overseas.

The findings should have an impact even without further intervention, since the practicalities of making payments to smallholders for carbon sequestration are under active consideration and review by many organisations throughout the world. Recent increased concern re global warming has brought this issue even more to the forefront. However, to increase the likelihood of a direct project impact in Indonesia (versus indirect), a follow on project (ASEM/2002/066) was implemented in an effort to input directly the concepts elucidated here into project designs in Indonesia.

CP/1994/126: Cassava safety: Development and evaluation of simple tests of the cyanogenic potential of cassava flour and cassava tubers

Overseas Collaborating Countries	Indonesia, Mozambique
Commissioned Organisation	Australian National University, Division of Botany and Zoology, Australia
Project Leader	Dr Howard Bradbury Phone: (02) 6125 0775 Email: howard.bradbury@anu.edu.au
Collaborating Institutions	Research Institute for Food Crops Biotechnology, Indonesia Ministry of Health, Mozambique
Project Budget	$380,096
Project Duration	01/01/1995 to 30/06/2004 (Project extended from 01/01/1996 to 30/06/2004)
ACIAR Research Program Manager	Dr Wendy Morgan

Project background and objectives

Cassava is the staple food of more than 500 million of the poorest people in the humid tropics. The edible tubers and leaves both contain cyanogenic glucosides that are broken down by endogenous enzymes to produce hydrogen cyanide, a potent poison. Cassava cultivars containing medium-to-high amounts of cyanogenic glucosides (bitter cassava), unless treated to remove cyanide, can be a health hazard; those varieties with low amounts of cyanogenic glucosides (sweet cassava) are innocuous. In eastern and central Africa (particularly Mozambique, Tanzania and Congo) cassava is mainly processed to flour, but there have been outbreaks of a permanently crippling disease amongst children and women called 'konzo' due to cyanide in their food. Programs of nutritional education to avoid this problem require a way of measuring cyanogenic potential of flour, but the previously developed method for fresh cassava is not applicable to flour. This project aimed to develop a simple, semi-quantitative method suitable for cassava flour and to field-test it in Mozambique and in Indonesia, where cassava flour is used in bread as a partial substitute for wheat flour, and where village-level flour millers had no ability to measure cyanide potential in their product. A simple indicator of cyanogenic potential of tubers has generally been regarded as taste, either bitter or sweet, but previous work had shown that this was not always the case. The project ran further sets of tests to establish the relationships definitively. Additional aims included development of a simple kit for determination of thiocyanate in urine, free distribution of cyanide and thiocyanate test kits to health and agricultural workers, adaptation of the cyanide kit to determine total cyanide in cassava leaves and roots and leaves of other cyanogenic plants, and studies of the incidence and prevention of konzo in Mozambique.

Project outcomes

The project achieved all its original objectives and more. It started as a small initiative to develop a kit for use under field conditions to determine the cyanogenic potential of cassava plant material. This developed into several kits to test different cassava materials and other plants. The kits have been used successfully to determine total cyanide in cassava roots, in cassava products such as flour, in leaves of various cyanide-containing plants including sorghum, in bamboo shoots and in flax seed meal. A kit was also developed to measure thiocyanate in human urine, which indicatess recent cyanide intake in people and animals.

The cyanide-in-cassava and thiocyanate-in-urine kits were used in a four-year longitudinal study of the occurrence of konzo in Nampala Province, Mozambique. Konzo is endemic in northern Mozambique and its occurrence is linked to high cyanide levels in flour, which occurs especially after periods of low rainfall. The study has led to development of strategies for its elimination. These include introduction of low-cyanide, high-yielding, disease-resistant varieties of cassava suitable for southern and central Africa; increased agricultural production to broaden the diet by introduction of

other staples, vegetables, pulses and fruit; improved processing of cassava roots to remove cyanide; and improved early warning systems of risk of konzo, based on reliable rainfall data and monitoring of cyanide levels in flour and thiocyanate in urine using the kits.

The project supplied free kits to more than 100 health workers and agriculturalists in developing countries. Demand for the kits increased steadily over the life of the project, to a level of about two kits per week (100 per year). The project also led to the establishment of a 'Cassava Cyanide Diseases Network', to assist all those who rely on cassava as a staple food with problems resulting from cyanide overload. Kits have been widely distributed to African countries with konzo problems, and to other parts of the world. Protocols for use of the kits have been translated into Bahasa Indonesia (with financial assistance from ACIAR for their printing), and into French (not by ACIAR).

CS2/2000/093: Development of a diagnostic key for tropical rice disorders

Overseas Collaborating Countries	Indonesia, Philippines
Commissioned Organisation	University of Queensland, Australia
Project Leader	Professor Geoff Norton Phone: (07) 3365 1854 Email : g.norton@cbit.uq.edu.au
Collaborating Institutions	Research Institute for Rice, Indonesia International Rice Research Institute, Philippines Philippine Rice Research Institute, Philippines
Project Budget	$149,949
Project Duration	01/01/2001 to 31/12/2003 (Project extended from 01/01/2003 to 31/12/2003)
ACIAR Research Program Manager	Dr Paul Ferrar

Project background and objectives

The project took existing but dispersed information on all sorts of rice disorders (growth stresses, nutrient disorders, pests, diseases, etc. and incorporated them within a highly user-friendly, computer-based diagnostic key using LucID software, to give anyone who needs to solve these problems a unified and easy-to-use source of complete information and problem diagnosis. No single source and tool of this nature has previously been available. LucID technology, developed in Australia by the Commissioned Organisation for this project, is now recognised as world-leading for this type of diagnostic information presentation and processing. Individual objectives are to develop the logical structure for the key, obtain relevant information on all disorders of tropical rice (text and graphics), develop a prototype key, field-test the key in a training course on rice disorder diagnosis, refine the key into a definitive version and prepare the key for availability on the Web.

Project outcomes

The main output from the project was the parallel development of two 'Rice Doctor' products—an on-line (flow chart) diagnostic key, situated on the IRRI Knowledge Bank Internet site, and a LucID (matrix) diagnostic key designed to be available on CD and the Internet. The on-line 'Rice Doctor' key is now available for users to access across the Internet—it can be accessed at the website http://www.knowledgebank.irri.org/ricedoctor_mx/ricedoctor.htm. The LucID matrix key is to be incorporated in the next version of the CD product—RiceIPM—published jointly by CBIT and IRRI (see more information on http://www.cbit.uq.edu.au/software/riceipm/). This LucID key version of 'Rice Doctor' will also be made available on the Internet.

Both diagnostic keys allow users to systematically diagnose specific field problems by selecting those features and symptoms they observe in the crop. As features are selected, a short list of likely causes of the problem is filtered out from over 80 possible causes. The LucID key includes numerous images to help users diagnose their problems and access relevant information about the problem. The features and symptoms that might be observed are defined and illustrated by notes and images. Both keys provide access to summary information sheets and full information sheets that contain images, text descriptions of symptoms and signs and pertinent information about particular insect pests, plant diseases, nutrient disorders and other causes of rice crop problems.

FIS/1997/073: Improved hatchery and grow-out technology for grouper aquaculture in the Asia-Pacific region

Overseas Collaborating Countries:	Indonesia, Philippines, Thailand
Commissioned Organisation	Queensland Department of Primary Industries, QDPI Northern Fisheries, Australia
Project Leader	Dr Mike Rimmer Phone: 07 4035 0109 Email: Mike.Rimmer@dpi.qld.gov.au
Collaborating Institutions	CSIRO Marine Research, Australia Bluewater Barramundi Ltd, Australia Research Institute for Coastal Fisheries, Indonesia Southeast Asian Fisheries Development Centre, Philippines Network of Aquaculture Centres in Asia Pacific, Thailand Research Station for Coastal Fisheries, Indonesia Australian Barramundi Farmers Association, Australia
Project Budget	$805,406
Project Duration	01/07/1999 to 31/12/2003 (Project extended from 01/01/2003 to 31/12/2003)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Groupers are reef fish of considerable economic importance. Their high value means that there is much interest in the development of aquaculture for them, particularly in the Asia-Pacific region and in Australia. The large and increasingly affluent market for live reef fish such as grouper, particularly in Hong Kong and southern China, has increased pressure on stock in the wild. In many areas the demand for live reef fish, and the large profits to be made by their supply, has encouraged over-fishing and the use of destructive and environmentally damaging practices to acquire the fish. This includes putting sodium cyanide in the sea to immobilise the fish so that they can be caught easily by divers. Many fish, and presumably other organisms, are killed in the process and the reefs are devastated.

Much of this can be avoided by growing desirable reef fish in aquaculture. The main problem restricting aquaculture for groupers is their very variable, and often rather poor, survival in the larval stage. Another difficulty is the supply of fish for feed — referred to as 'trash' fish. These low-value fish, which could be used for human consumption in low-income countries, are increasingly being put into aquaculture feeds for high-value fish. In some areas their supply is dwindling.

Recent international workshops have identified areas where research is necessary to develop commercially viable aquaculture for groupers. The overall objective of this project was to increase production of grouper reef fish in the Asia-Pacific region by developing improved hatchery and grow-out technology.

Project outcomes

Larval rearing

- Optimising environmental variables of temperature, salinity, aeration, and light levels provided valuable information contributing to greater larval survival.
- Larval nutrition research indicated the essential fatty acid requirements of one species of grouper (*Epinephelus coioides*). Further work will be aimed at developing larval diets to provide suitable levels of various fatty acids the larvae require.
- Research described the development of the digestive tract in larval groupers. This is fundamental to knowing the capacity of the larvae to digest both live and artificial feeds.
- Highly sensitive fluorescent techniques were developed to assess the levels of digestive enzymes in the gut of fish larvae. Grouper larvae were shown to have very low levels of digestive enzymes (e.g. protease) compared with some other species of fish larvae that have been examined, such

as barramundi. This may help explain why grouper larvae are more difficult to rear than barramundi.
- Assessment of techniques to maintain or decrease the size of super-small (SS) strain rotifers (*Brachionus rotundiformis*) for use in grouper hatcheries.
- Improved intensive and semi-intensive larval rearing techniques resulted in survival rates increasing from around 3% at the beginning of the project to 30% for greasy grouper / estuary cod (*E. coioides*), and from 5% at the beginning of the project up to 50% for humpback grouper / barramundi cod (*Cromileptes altivelis*).
- The viral disease viral nervous necrosis (VNN) continues to cause major mortalities in hatchery-reared grouper and remains a major limiting factor in successful seed production.
- Technology developed under the project has been adopted by farmers, including 'backyard hatcheries' in Bali. A socio-economic analysis of these small-scale hatcheries demonstrated that they are highly profitable, with payback periods generally <1 year and IRRs of 12–356%.

Grow-out diet development
- Protein of Australian meat and bone meal and wheat gluten and local and imported fishmeal was found to be well digested (Apparent Digestibility (AD) >76%). The protein digestibility of Australian blood meal was variable but generally low as also was the digestibility of rice bran. Intermediate in protein digestibility were local ingredients such as shrimp head meal, palm oil cake meal and soybean meal.
- Research with humpback grouper / barramundi cod (*C. altivelis*) showed that diets had to be high (> 55%) in protein and moderate (12–15%) in lipid to optimise growth rate and nutrient retention in the fish. Increasing the amount of lipid in the diet only increased fat deposition without any improvement in growth or food conversion efficiency. These findings need to be confirmed with other grouper species.
- Other research showed that many terrestrial protein meals have potential as partial replacements for fishmeal in grouper grow-out diets. Good quality meat and bone meal can replace more than two-thirds of the fishmeal without any adverse effect on grouper performance. Plant protein meals such as soybean and lupin have been shown capable of successfully replacing from one-third to half of the fishmeal.
- Researchers in Indonesia have categorised (cost, seasonal availability, composition, digestibility) a range of potential ingredients for use in locally-made grouper diets.
- Commercial feed producers in Indonesia and the Philippines are now trialing grouper diets based on the outcomes of the project's research.

FIS/1997/165: Biology, fishery assessment and management of shared snapper fisheries in northern Australia and eastern Indonesia

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Steve Blaber Phone: 07 3826 7214 Email: stephen.blaber@csiro.au
Collaborating Institutions	Department of Primary Industries and Energy, Australia Centre for Agro-Socio Economic Research and Development, Indonesia Research Institute for Marine Fisheries, Indonesia Central Research Institute for Fisheries, Indonesia Directorate General of Fisheries, Indonesia Department of Primary Industry and Fisheries, Northern Territory, Australia
Project Budget	$1,155,204
Project Duration	01/01/1999 to 31/12/2002
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Red and goldband snapper stocks are harvested in both Australian and Indonesian waters, employing a variety of methods including trawl, drop-line and bottom longline. Little has been known of the stock structure, distribution and movement of these shared fish stocks. Furthermore, data on the population biology and on commercial catches were inadequate. These data are crucial for stock assessment and management of stocks.

In planning the ACIAR project it was recognised that those fishing Australian waters targeted both red and goldband snapper, while the latter is sought after by the Indonesian fishery but any other miscellaneous species were also landed. It was initially assumed that in Indonesian waters the artisanal fishery was likely to be taking a significant portion of the red and goldband catch, although there was a large fleet of foreign vessels in Indonesian waters. This assumption was tested in the course of the project.

The project aimed to provide advice on stock structure and biology relevant to the management of red and goldband snapper species in northern Australia and eastern Indonesia, and also to describe the social and financial structures that might be affected by future management strategies for the fisheries; further, to assess the state of the snapper fisheries and explore the types of complementary management strategies suitable to ensure their long-term sustainability.

Project outcomes

The project achievements have already made a significant contribution to the future management of the shared fish stocks of Australia and Indonesia. Employing a range of analytical methods the scientists demonstrated that, while separate stocks of red and gold snapper exist and are fished in Indonesian waters, in the shared fishery red and goldband snappers are fished jointly. They gathered a wealth of information about the spawning, growth rates and age composition of different populations. A significant finding was that red snapper aged 5–6 years collected from Indonesian waters were on average larger than fish of the same age collected from Australian waters.
The scientists determined through yield- and egg-per-recruit analyses that the fishnet fishery placed the future sustainability of the snapper fishery at considerable risk, largely because it caught too many small fish. They also found that the type of fishing gear used by the Australian fishery tended to catch greater quantities of smaller fish, and recommended investigation of traps to determine their effect on catches. The scientists' use of a biomass dynamics model produced further evidence that the current levels of catch of red snapper would be unsustainable in the longer term.

At the start of the project the scientists found that the data collection system in use by Indonesia was not producing reliable estimates of catches of the three snapper species. An improved system of data collection enabled the discovery that the small-scale artisanal Indonesian fishery for snapper took a relatively small annual catch compared with those taken by the bottom longline and fish net boats.

Researchers found that in Indonesian waters the licensing system was inadequate for vessels greater than 30 tonnes. In fact Indonesia derived very little economic benefit from catches taken by the net fishery and was providing a fuel subsidy to the fish net boats from Thailand. Now changes introduced in the course of the project have led to a much improved licensing system.

The involvement of policy/decision makers and fishery managers within the project gave them an awareness of the science, and in return they provided advice on the impact and suitability of alternative strategies for future management of the fishery.

The project's success has been the catalyst for further collaborative research projects, on tuna and on sharks and rays.

FIS/2000/062: Artisanal shark and ray fisheries in eastern Indonesia: their socioeconomic and fisheries characteristics and relationship to Australian resources

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Steve Blaber Phone: (07) 3826 7200 Email: stephen.blaber@marine.csiro.au
Collaborating Institutions	Murdoch University, Australia Indonesian Institute of Sciences, Indonesia Central Research Institute for Fisheries, Indonesia Centre for Agro-Socio Economic Research and Development, Indonesia Research Institute for Marine Fisheries, Indonesia
Project Budget	$290,669
Project Duration	01/01/2001 to 31/12/2003
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

This project arose from a workshop held in Bali in March 2000, which established a Shark Technical Working Group. The Group has identified several major issues regarding elasmobranch (shark, skate and ray) fisheries and opportunities for collaboration between Australia and Indonesia—including the lack of species composition data for the fisheries, the extent of shared stocks between Australia and Indonesia and the socioeconomic structure of the different fisheries. The overall objective of the project was to develop an understanding of the socioeconomic characteristics of the artisanal shark and ray fishery in southeast Indonesian waters and to provide a preliminary assessment of the biological status of the fishery. Researchers provided training and advice to Indonesian scientists to assist them in determining the best possible alternative management options for the fishery.

Project outcomes

This project commenced in January 2001, and formally concluded in June 2003. The major research issues were: to establish, through collaboration with Indonesian institutions, appropriate sampling protocols for the ongoing collection of data needed to evaluate the socio-economic status of the elasmobranch fisheries and accurately describe them; to assess the population status of the key species harvested by these fisheries (particularly those shared with Australia); to provide advice to Indonesian scientists in relation to developing future management strategies. A major output of the early phase of the project was the creation of the necessary databases and the establishment of ongoing monitoring.

Thus the requirement to review Phase 1 of this project well before the availability of any final reports meant that the information was mostly of a preliminary nature. This was particularly true of aspects of the component of the project dealing with socioeconomics. Subsequent discussions with project participants helped to clarify a number of issues and provided additional information. While the reviewers were assured that all of the necessary socioeconomic data had been collected, the very preliminary nature of much of the information available to the reviewers made it difficult to determine the extent to which all of the anticipated outputs had been achieved. For example, a detailed understanding of the critically important 'social structure' of the fishing and related communities was unclear at this stage. In contrast, the components of the project that dealt with the collection and analysis of biological and market survey data, the descriptions of the fisheries, and the biology of the key species, were well advanced.

FIS/2000/128: Community-based management of the Terubuk fishery in Riau, Indonesia

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Steve Blaber Phone: 07 3826 7214 Email: stephen.blaber@csiro.au
Collaborating Institutions	Directorate General of Fisheries, Indonesia
Project Budget	$115,535
Project Duration	01/01/2001 to 31/12/2002
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The terubuk (*Tenualosa macrura*) is an economically and culturally important fish for coastal communities in Riau Province of Sumatra, Indonesia. This project built on the earlier research of a small ACIAR project, which established that stocks of this species were severely depleted, with over-fishing and low water quality identified as the key contributing factors to low terubuk catches. Over-fishing was especially severe because the fishers concentrated on spawning grounds in order to capture the gravid females, prized for their eggs. A major water quality issue concerned the high volumes of sawdust occurring in areas where terubuk live.

The two major issues to be resolved in order to finalise management measures were: (1) an accurate definition of the spawning areas that may need protection; and (2) the socioeconomics of how any management measures may impact on local communities and other stakeholders. An appropriate strategy for the management of the terubuk fishery resource had to include coastal community participation and be based on information covering the biology and economics of the fishery, its socio-cultural aspects, and the socio-economic characteristics of coastal communities. Possible strategies for conserving and managing the terubuk fishery resource could include controlling fishing effort and controlling the release of sawdust from sawmills into the Siak River. This could result in, at least temporarily, some unemployment or temporal closure of key spawning areas. Therefore, the extent to which the community depended on terubuk and alternative income sources had to be understood, and this could only be obtained through a comprehensive consultative process with all stakeholders. Such a process would produce a management plan that led to effective conservation of the Terubuk fishery.

The major objective was to work with all stakeholders of the terubuk fishery - fishers, fishing communities, fisheries management, NGOs and sawmill operators - to develop an overall management plan to ensure the survival of the fishery, then as stocks recovered to encourage its expansion to a sustainable level, without creating undue hardship for any of the stakeholders.

Project outcomes

A plankton sampling program was conducted at 17 stations where terubuk were known to occur, to describe the distribution and abundance of terubuk larvae and better define spawning areas. These included 11 sites in the sheltered coastal straits inside Bengkalis Island and six sites in the Siak River, which drains into the coastal waters. The most notable feature was that larvae of terubuk and all related types were in very low numbers in the terubuk spawning grounds – indicationg that the targeted fishing of pre-spawning aggregations may be leading to recruitment failure.

Wood waste material in the waterways caused some terubuk to die before spawning and reduced the number of viable larvae, thus reducing the total population. Terubuk are filter feeders and cannot choose their food - they filter out any small material that is about the same size as their natural food (plankton). Small wood particles about the size of sawdust constituted up to 80% of the stomach contents of terubuk. The fish cannot digest large amounts of woody material, thus leaving too little space in the stomach for plankton - poor nutrition caused terubuk at all growth stages to be thin. The

survivors may be less able to accumulate enough fat to change from (male) pias to (female) terubuk, and the females may not accumulate enough fat to produce large numbers of viable eggs.

The scientists concluded that banning gillnets in the spawning areas during the spawning periods was necessary, urgent and indispensable, as terubuk could not be restocked from a hatchery. They presented their conclusions to a meeting of key decision-makers and stakeholders.

The Indonesian participants accepted all the project recommendations, but at the Final Project Coordination Meeting the scientists reminded those present that none of the recommendations agreed to in late 2001 had yet been implemented. Terubuk populations continued to decline and it was urgent to close the spawning grounds to gillnets under 7 inches. The stakeholders resolved to take action.

Since 1999–2000 much of the forest resource of the Province has gone, and sawmilling has either ceased or is a greatly reduced activity. Hence the amount of sawdust produced and disposed of into the water has declined. Actions now revolve around preventing old sawdust from leaching into waterways and the control of dumping other woody wastes.

FIS/2001/079: A review of Indonesia's Indian Ocean tuna fisheries and extension of catch monitoring at the key off-loading ports

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	CSIRO Marine Research, Hobart, Australia
Project Leader	Dr John Gunn Phone: (03) 6232 5375 Email: john.gunn@csiro.au
Collaborating Institutions	Research Centre for Capture Fisheries, Indonesia Bogor Agricultural University, Indonesia
Project Budget	$193,705
Project Duration	01/01/2002 to 31/12/2003
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Scientists know little about the status of Indonesian tuna fisheries, both in terms of total catch and of key parameters such as catch per unit effort and size distribution of catches. This project undertook a 15-month pilot study to produce 1) a status report on Indonesian tuna fisheries in the Indian Ocean (including a review of existing data collection systems) and 2) a system for the collection, storage and analysis of all catch data from the longline fleets operating out of Benoa in Bali, and Muara Baru and Cilacap in Java. The outcomes of this study provided vital information for Indonesia and Australia, and also the two regional fisheries management organisations—the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) and the Indian Ocean Tuna Commission (IOTC). Thus the study should assist longer-term planning of research programs to develop and improve Indonesia's capacity to monitor and manage its Indian Ocean tuna fisheries, and to represent itself with the regional fisheries management organisations.

Project outcomes

Country tuna status report

Through reviews of literature, discussions and workshops with a broad range of stakeholders (including government fishery managers, scientists and peak industry bodies) and analysis of historical data, the project produced a Country Status Report. This examines the extent and accuracy of Indonesia's tuna fishery data for the Indian Ocean, and the existing systems for data collection and reporting on tuna fisheries at district, provincial and national levels, for industrial and (to a lesser degree) artisanal fisheries. It is clear that the current systems for fisheries data collection and reporting were designed primarily to provide national production statistics, not for science-based stock assessments to support sustainable management of stocks at a species level.

The Country Status Report found a number of deficiencies in the Indonesia's fishery data/statistics that severely limit their usefulness for stock assessment. For example, catch is most often not recorded at the species level, and for national statistics all the *Thunnus* species are lumped under the single category—'tuna'. There is also significant duplication in catch and fleet operations data collected and reported at different levels of government, and inadequate effort is made to validate the accuracy of these data.

The report makes recommendations on ways in which these shortcomings can be overcome. It recommends a high-level working group be formed to:

- Determine the resources required at provincial, district, and sub-district level to enable adequate coverage by surveys of catch and fleet, both in geographical and temporal terms.
- Investigate how the various port offices (WASKI, Port Authority) and Government fisheries offices (district and provincial) can be better coordinated to reduce duplication of effort and make most efficient use of available resources.
- Investigate ways to reduce any duplication of effort between the branches of Central Bureau of Statistics, and those of the Directorate General of Capture Fisheries (DGCF).

- Ensure consistency in the type and quality of data collected between provincial, district and local systems.

To improve the incentives for provision of accurate data by industry, the researchers recommended that the government examine options for separating the data collection systems used by District government (or other offices) to calculate the amount of tax payable by fishing companies, from the systems/procedures used to compile fisheries statistics, or at least improve validation of catch data at the source of collection. The data collection and validation systems should be built on a partnership between Government and industry, and include incentives for compliance with regulations at the same time as penalties for non-compliance.

They also recommended that regulations be introduced that enforce accurate and prompt reporting of catch by fishing companies. To improve the efficiency and accuracy of data collection systems, and ensure that the data collected is useful for stock assessments, they recommended that catch sampling/catch surveys include separation of tuna species and increased rigour in the validation of catch data.

The review paper recognised the significant improvements made by DGCF in recent years in the registration of vessels, removal of FOC (foreign owned company) vessels, and in the enforcement of government regulations. However, to correct the inconsistencies in the recording of vessel activity and registration, it was recommended that vessel registry licensing systems, both at the National (currently for vessels > 30 gross tonnes), and Provincial (vessels < 30 gross tonnes) levels be reviewed.

Catch monitoring

The project successfully established a monitoring program at the three major ports at which tunas and billfishes are landed by Indonesia's Indian Ocean industrial longline fishery. The program meets the requirements of the Commission for the Conservation of Southern Bluefin Tuna and the Indian Ocean Tuna Commission for reporting of species and size composition of Indonesia's tuna and billfish catches. Capacity to collect and manage tuna fisheries data involved developing a team of trained enumerators from the Research Institute for Marine Fisheries (RIMF) to sample catches at the point of landing/processing in each port and a vessel activity logging program run by the port authority or WASKI, both supported by a unified database—WinTuna, enabling centralisation of all information collected.

FST/2000/016: Breeding to enhance productivity of plantations of melaleucas for essential oil production in Indonesia

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Dr John Doran Phone: 02 6281 8319 Email: john.doran@csiro.au
Collaborating Institutions	NSW Agriculture, Australia Centre for Forest Biotechnology and Tree Improvement, Indonesia
Project Budget	$131,976
Project Duration	01/01/2001 to 31/12/2002
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Cajuput oil, based on foliar essential oils from *Melaleuca cajuputi*, is popular throughout Asia as an antiseptic and medicine. Oil extraction is an important source of employment in Java, but the plantations on which the industry depends are in need of replacement. This ACIAR small project built on two earlier small non-ACIAR projects.
The first, supported by the Collaboration on Science and Technology Australia-Indonesia (COSTAI), allowed collection of seed of *M. cajuputi* ssp. *cajuputi* in the natural stands on the Maluku islands and in northwestern Australia. This seed was used to plant a limited breeding population at Paliyan near Yogyakarta. The second, supported by AusAID's Government Sector Linkages Program (GSLP) for Indonesia, allowed further seed collections in Maluku and on Java and preparation of a breeding strategy.

This project aimed to complete the earlier research work by refining and implementing a breeding program for *M. cajaputi* ssp. c*ajuputi* in Indonesia.

Project outcomes

Implementation of the breeding strategy for improving oil yields and oil qualities of *M. cajuputi* commenced with the start of this project in January 2001. Breeding trees is a long term undertaking and two years is insufficient time to produce the highly improved seed that will ultimately be the product of project seed orchards and to test the impacts of its use.

All stakeholders in the project are awaiting the availability of commercial quantities of seed from the seed orchard. No impediments to adoption of the improved seed are envisaged, as it will be the preferred seed source for all future plantings of *M. cajuputi* on Java once it is readily available. The new orchards are expected to produce their first seed crops in 2004 and substantial crops from 2006 onwards.

Scientists therefore can only take an educated guess at impacts, based on data when available from project trials and on melaleuca tree improvement work elsewhere. They have predicted gains of up to 20% in growth traits and 20% in oil concentration. These estimates are consistent with gains recorded in a tea tree oil (*M. alternifolia*) improvement project in Australia.

Comparison of these figures with current average production figures for *M. cajuputi* in Indonesia lead to prediction of oil yield increases from 62 to 86 kg per hectare - an improvement of A$240 per hectare at the distillery gate. In addition worthwhile improvements in oil quality would ensure that all of the production meets the minimum Grade A standard of 55% 1,8-cineole. Even greater yield improvements can be predicted once the larger project seed orchards are thinned and start producing seed in a few years time.

In the study of composted spent biomass scientists found that its addition to soil enhanced plant growth and led to significant improvement in crop yields. Thus it holds promise as a soil improver and after further development may be an additional product out of the oil industry.

FST/2000/122: Application of molecular marker technologies for genetic improvement of forest plantation species in Indonesia and Australia

Overseas Collaborating Countries:	Indonesia
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Dr Gavin Moran Phone: 02 6281 8208 Email: gavin.moran@csiro.au
Collaborating Institutions	Gene Technics, Australia Gadjah Mada University, Indonesia Centre for Forest Biotechnology and Tree Improvement, Indonesia
Project Budget	$393,733
Project Duration	01/01/2001 to 30/06/2003 (Project extended from 01/01/2003 to 30/06/2003)
ACIAR Research Program Manager	Dr John Fryer

Project background and objectives

Plantations using species of the Australian genera *Eucalyptus* and *Acacia* have been established in many parts of the tropics and subtropics because the species used are fast-growing and produce wood that can be used for fuel, pulp, roundwood and sawlogs – as well as for non-wood forest products such as oils and tannins. The plantations are now important components of the rural economies of many developing countries and also in Australia, where farmers are planting eucalypts in the southern parts as an alternative to livestock.

However, although plantation acacias in Indonesia have proved successful, their growth rates have been well below the known optimums for the species. Poor provenance selections were used in some plantations and, in others, early seed orchards were found to have high levels of inbreeding that depressed growth rates.

In Australia, trees from both genera have been improved by selective breeding, but the application of newer molecular techniques will enable further improvements in productivity to take place. Indonesia, where both tree genera occur naturally, is one of the few countries in the region with sufficient skills and facilities in the forestry sector to take advantage of the new technology, if given some assistance.

In 2000, Indonesian scientists approached CSIRO Forestry and Forest Products, which has developed an array of genetic markers for eucalypts and acacias and linkage maps for *E. globulus* and *A. mangium*. The result is a collaboration to marry molecular marker technology with existing research on controlled breeding. For eucalypts, marker aids will be used to select for traits such as frost tolerance (for southern Australia) and rooting ability. For acacias, the work will determine the levels of inbreeding and gene flow, and the parentage of selections, in seed orchards.

The objectives of this project were to improve breeding programs of *Acacia* and *Eucalyptus* by using molecular procedures to determine parentage and assess inbreeding.

Project outcomes

CSIRO had developed DNA marker technologies in acacias prior to this project. The primers and all available information for the 33 microsatellite loci developed by CSIRO FFP were transferred to the molecular laboratory at CFBTI. Optimisation of microsatellite assays was carried out at CFBTI with assistance of CSIRO personnel and 16 primers are now optimised to work in the CFBTI laboratory. A key output was training of CFBTI staff in CSIRO laboratories to efficiently carry out microsatellite screening and to competently perform genetic analysis of molecular marker data.

A first generation open pollinated progeny/provenance trial was assessed for growth and form and plus trees selected. Open pollinated seed from the plus trees in subline D were planted in a 2nd

generation progeny trial and assessed for growth at 2 years of age. Two hundred and fifty-seven trees, including the plus tree selections, were DNA profiled by determining their multilocus genotypes at 15 microsatellite loci. All trees could be uniquely distinguished from one another. Microsatellite markers are sufficiently powerful to enable efficient monitoring and quality control in Indonesian breeding programs of *A. mangium*.

Progeny from each of 10 plus trees were assayed at the same 15 loci, and parentage analysis carried out to determine the unknown male parent. About half of the progeny could be assigned both parents with some confidence. There was no significant relationship between degree of genetic relatedness of parents and the performance of the progeny. Progeny could be classified into groups due to interfamily, inter provenance and self crossing. There were no differences between these groups in diameter growth but some significant differences were present in form. It also highlights that these methods can allow classification of breeding material into structures previously unavailable in acacias and most tree breeding programs. This is a very exciting result. However, there appeared to be very significant errors in progenies sampled which were largely not due to laboratory mis-scoring. This result if found to be more broadly applicable to genetic trials has serious implications for the breeding programs of *A. mangium* in Indonesia and suggests that CFBTI can play a central role in monitoring breeding programs.

A provenance field trial in South Sumatra was used to determine genetic diversity levels in 9 provenances covering the main geographic range of *A. mangium,* and the land race from Subanjeriji. For each provenance 30 randomly selected trees were assayed for their microsatellite genotypes at 12 loci and population genetic parameters estimated. Heterozygosities were very high with an average He of 0.66 across all trees but with marked differences in levels of diversity between geographic regions. The land race had a very low level of observed heterozygosity with evidence of significant inbreeding. A major objective was to test whether genetic diversity parameters at the individual tree level and the provenance level were associated with growth. For 15-month growth data only means at the provenance level were made available whereas 5 year data were available at the individual tree level. At the provenance level regressions of heterozygosities with mean heights and mean diameters of 15 month data were significant. However the provenance means for 5 year diameter data were not significantly related to heterozygosities. Similarly, at the individual tree level 5 year diameter growth was not significantly associated with observed heterozygosity. The fifteen month results are suggestive that early selection in the nursery based on levels of observed heterozygosities may be possible. Nevertheless, selection has to be at the individual tree level so further research is needed to firmly establish this relation for individual trees. Analysis of growth data suggests some uncertainty as to whether the sampling was sufficiently random in selecting trees for this study.

In acacias it has proved extremely difficult to generate large numbers of seed from control pollinations. An alternative approach was to be tested in which minibreeding arboreta were used to generate open-pollinated progeny involving a limited number of parents but using multiple clonal copies of each parent. The seed could be assigned full parentage using microsatellite analysis. In the second half of 2001, two pollarding experiments were carried out on 2-year-old operational plants to generate shoot cuttings. In both experiments viable cuttings were not propagated. The need to clonally propagate plus tree selections in breeding programs for a variety of reasons makes it essential that the clonal propagation issue be resolved as soon as possible. The development of minibreeding arboreta in this project did not proceed because of lack of success at macropropagation

Leaf rust, *Atelocauda digitata*, infected young 2nd generation progeny trials in South Sumatra in early 2001. The progeny tests of subline D and F were assessed for rust susceptibility to investigate the genetic control of rust resistance. Differences between families in leaf rust susceptibility were highly significant mainly due to one very susceptible family from the Subanjeriji land race. In subline F the differences between families was not significant and heritability was very low at 0.02. With such low heritabilities QTL detection will be very difficult and not recommended and phenotypic selection, preferably based on clonal trials, would be a better approach in the breeding program.

A genetic linkage map for the hybrid eucalypt pedigree was constructed with 117 progeny and 125 markers. The map consisted of 11 linkage groups and a total size of 1100cM with an average of 11

markers per linkage group. The map shows close agreement with our previously published maps of *E. globulus* and *E. nitens.* There was evidence of significant segregation distortion on parts of two linkage groups perhaps due to mating incompatibility between the species. In this pedigree the overall percentage rooting for stem cuttings was low at 22.7% probably reflecting the globulus background in the pedigree. QTL analysis consisted of single factor analysis of variance for each locus and was carried out for mean rooting across all three settings. Frost tolerance was assessed using an electrical conductivity measure and ANOVA analyses were on both the first assessment alone and means across all three assessments. Six QTL regions for rooting of stem cuttings were located on the genetic map and two of these appeared to be the same QTL as previously reported in *E. nitens*. For frost tolerance five QTL regions on the map were found. The strongest QTL was on linkage group one and had not previously been characterised. Two QTL for frost tolerance appeared to be the same as reported in *E.nitens*. Hopefully further genomics research will collocate genes to these QTL and allow development of methods to more efficiently select for these traits in breeding programs.

Cloned progeny from the two pedigrees were planted in a field trial near Deniliquin in NSW in 2002. When old enough they will be assessed for commercial traits and a combined selection strategy developed for rooting, frost and the commercial traits.

LWR2/1996/215: Capturing the benefits of seasonal climate forecasts in agricultural management

Overseas Collaborating Countries:	India, Indonesia, Zimbabwe
Commissioned Organisation	Queensland Department of Primary Industries, Australia
Project Leader	Dr Jeff Clewett Phone: 0746 881 244 Email: clewetj@dpi.qld.gov.au
Collaborating Institutions	Agency for Agricultural Research and Development, Indonesia University of Mataram, Indonesia Tamil Nadu Agricultural University, India Zimbabwe Meteorological Services, Zimbabwe University of Western Sydney, Australia Bureau of Meteorology, Australia Matopos Research Station, Zimbabwe Badan Meteorologi dan Geofisika, Indonesia Queensland Department of Natural Resources, Australia
Project Budget	$982,927
Project Duration	01/01/1999 to 31/12/2002 (Project extended from 01/01/2002 to 31/12/2002)
ACIAR Research Program Manager	Dr Tony Fischer

Project background and objectives

Climate variability has a huge effect on agricultural production and the general well-being of communities across the world. An understanding of variability is particularly important in those countries (Australia, Indonesia, India and parts of Africa) affected by the El Nino/Southern Oscillation (ENSO) phenomenon, because ENSO can cause large swings in rainfall. The severe droughts associated with one phase of the cycle can bring extensive fires, crop losses and famine.

Generalised rainfall prediction several months in advance has long been possible by analysing sea surface temperatures and air pressure differences in key locations around the world. On top of this, considerable progress has been made in the last decade in understanding the atmospheric and oceanic processes causing ENSO and its periodic manifestations of drought, and this knowledge is now used to make more accurate seasonal climate forecasts.

Timely knowledge of upcoming climatic conditions can greatly benefit farmers and land managers, especially in areas where rainfall is inherently variable and unreliable. However, detail of the forecasts does not often translate into action by farmers and other key resource managers. This project sought to capture the benefits of the new, detailed climate forecasts and thus improve agricultural management in ENSO-affected areas.

Project outcomes

The project showed that translating relatively recent ENSO knowledge into useful information for managing risks and opportunities associated with climate variability is a challenge for traditional agricultural research and extension. Researchers improved the skill and value of forecasting, increased the lead time for prediction, identified the key decisions and practices in the farming cycle to which forecast information may be applied, and communicated information in a risk-management context.

The project made important contributions to increasing the understanding of ENSO in Indonesia, where the impact is as great as anywhere in the world. A key finding was that the changing seasonal pattern of spatial coherence of rainfall correlated with predictions. Badan Meteorologi dan Geofisika (the Indonesian Bureau of Meteorology) has added this knowledge to its program for compiling seasonal forecasts.

A publication *'Will it rain?*' was produced in Indonesian and is an important means of communicating the state of the science. Decision-support tools developed for Lombok, Indonesia will assist analysis of stream flows and optimise water allocation decisions.

The development of an international RAINMAN version led to excellent progress in assembling a global database of monthly rainfall and some other data sets. Outputs for India and Zimbabwe have significantly increased understanding, particularly through use of simulation models to show amplified impacts on agricultural systems compared with ENSO impacts on seasonal rainfall.

A highlight was the successful calibration and validation of the GRASP pasture simulation model for Zimbabwe pastures. And in Tamil Nadu, India, scientists have assessed seasonal climate forecasts through farm surveys and workshops, and undertaken analyses using crop simulation models.

The project outcomes should lead to changes in farm management decisions, to better adapt farming to climate variability, and to prepare for climate change.

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

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

Project background and objectives

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

Project outcomes

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

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

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

An important output of this project is input in other ACIAR projects (PHT/1995/134 Management of Phytophthora diseases of durian; PHT/2000/102 Selection for improved quality and resistance to Phytophthora pod rot, cocoa pod borer and vascular streak dieback in Indonesia; and CS2/1994/965 Diagnosis and control of plant disease in northern Vietnam.) At the end of this project a workshop was held in collaboration with the durian project (PHT/1995/134) in Chiangmai in October 2002. During this workshop information regarding the occurrence, aetiology, and management of Phytophthora was reviewed and recommendations for integrated management of Phytophthora diseases discussed. In addition it brought together scientists from the collaborating countries to share information and form professional linkages throughout the region.

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

PHT/1997/161: Market based analysis of constraints to banana industry development in Indonesia and Australia

Overseas Collaborating Countries	Indonesia
Commissioned Organisation	Queensland Department of Primary Industries, Maroochy Research Station, Australia
Project Leader	Dr Peter J Hofman Phone: (07) 5444 9647, 0407173 608 Email: peter.hofman@dpi.qld.gov.au
Collaborating Institutions	Indonesian Agricultural Postharvest Technology Research Institute, Indonesia University of Queensland, Australia Central Research Institute for Horticulture, Indonesia
Project Budget	$149,998
Project Duration	01/07/2001 to 31/12/2003 (Project extended from 01/07/2002 to 31/12/2003)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Competitive pressures are rising throughout the food industry, and continued profitability depends on the efficient management of cost of production, reduction of waste, introduction of improved technologies and response to changes in the socioeconomic environment. All participants in the supply chain, from producers/smallholders to product handlers and marketers, must contribute to manage these factors and provide the product that the market demands. This small project used the banana industry in Indonesia and Australia as case studies to identify the major constraints to competitive performance in the two countries. This entails documenting the characteristics of the supply chain, identifying market requirements and the potential market and analysing product market performance. The study also charted future research and development needs.

Project outcomes

The nature of the project required expertise from a range of disciplines and organisations so that all the important aspects of supply-chain management from production to marketing and sale could be examined. A project team was formed comprising experts in banana production extension, marketing extension, participatory methods, postharvest technology and market research from at least four Indonesian government departments. A banana trader with a strong desire to improve his supply chain was also included. This represented a unique approach within Indonesian horticulture, where cross-departmental and industry collaboration was not usual.

Several meetings of the steering committee culminated in the supply-chain workshop, which was an important step in gathering information about the supply chain, the issues limiting industry development, and how to move forward. The workshop comprised representatives from the growers, traders, markets, retailers the provincial agriculture services and the steering committee. The information gathered from this workshop was supplemented with information gathered from desk research and from field trips. These involved examining two targeted supply chains—a traditional banana supply chain from the Cikalong subdistrict, Cianjur district, West Java, supplying mainly the traditional markets in Bandung and Jakarta, and company X supplying banana to supermarkets in the Jakarta, Bogor, Tangerang and Bekasi metro areas. Group and individual discussions were held with supply chain members and issues affecting banana production and quality were identified. This information was examined and collated in a two-day workshop held in Australia, attended by the Indonesian steering committee including market and regional representatives, and the Australian project team.

The workshop format was based on the methods used by the Australian team and the Supply Chain CD produced by the Australian Department of Agriculture, Forestry and Fisheries (DAFF). The results indicated that the most important constraint in both supply chains was getting the product right, since

the supply of quality fruit was a major limitation to expansion. This indicated that the current emphasis of research and development on improving on-farm production and postharvest practices was correct. However, additional factors also need to be addressed, such as getting adequate supply of the right product, and making sure that improvements do not negatively affect sociological and other aspects of the chain.

The Australian project team decided there was more benefit in using an existing commercial supply chain as a case study rather than workshops with industry representatives. Information on the supply chain was obtained by one-on-one interviews with key members of the chain, and with several prominent non-members. A supply-chain workshop was held where the key members were invited. The workshop process included mapping the flows of fruit, information and funds and a SWOT analysis to identify areas for improvement. The potential improvements were compiled and classified under the six principles of supply chain management: knowing customers and consumers, creating and sharing value, getting the product right, logistics and distribution, information and communication, and effective relationships. The key improvements were then prioritised using a voting system. The key priorities included expanding ripening facilities to ensure market growth, maintaining fruit quality and information flow while the business is expanding, and improving relationships within the company board.

Comments on the methods used in Indonesia and Australia are:

- It is more beneficial working with a commercial supply chain than to use industry representatives.
- The supply chain must have a strong champion who is willing to push for improvement. There is little chance of improvement if there is no champion within the supply chain.
- There also needs to be strong commitment from the other members of the supply chain. This was one of the failings of the Australian exercise, which resulted in reduced attendance at the supply-chain workshop.
- The priorities identified (including R&D priorities) depends strongly on the representatives at the meetings because of their biases and experiences. This reinforces the need for commitment and involvement from all key members of the chain.
- Group meetings can be less beneficial in the Indonesian context because the more hierarchical nature of their chain means that growers and possibly collectors are less likely to contribute to the meeting. One-on-one meetings or meetings with, for example, growers only, can be more beneficial.

These refinements are now being applied by the Indonesian agency partner to several other horticulture industries in Indonesia, with good results. The Australian experiences are being applied in other Queensland horticultural industries and to another ACIAR project being developed with the Philippines.

An International Supply Chain Workshop was organised in Bali in August 2003, attended by about 50 regional representatives. Experiences on using the supply chain concept in a range of projects were discussed. The discussions indicated that the supply chain approach is providing considerable benefits, and confirmed the significant role that the trader can play in driving change both up and down the chain. An ACIAR conference proceeding is in preparation.

Multilateral

AS1/1997/133: Sustainable endoparasite control for small ruminants in Southeast Asia

Overseas Collaborating Countries	Indonesia, Malaysia, Philippines, Thailand
Commissioned Organisation	International Livestock Research Institute, Philippines
Project Leader	Dr Greg Hood Phone: +63 2 845 0563 ext 2675 Email: ghood@cgiar.org
Collaborating Institutions	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Philippines Universiti Pertanian Malaysia, Malaysia Research Institute for Veterinary Science, Indonesia CSIRO Livestock Industries, Australia Veterinary Research Institute, Malaysia
Project Web Site	www.worminfo.org
Project Budget	$599,370
Project Duration	01/07/1998 to 30/06/2004 (Project extended from 01/07/2001 to 30/06/2004)
ACIAR Research Program Manager	Dr John Copland

Project background and objectives

This project was a significant component of the International Livestock Research Institute's (ILRI) extension to Southeast Asia. The broad aim was to bring together relevant experiences and expertise from ILRI and the Australian and Southeast Asian collaborating institutions to study endoparasites (internal parasites) in sheep and goats. The specific objectives were to develop, test and implement options for sustainable endoparasite control (SPC) strategies, to identify endoparasite-resistant goat breeds/genotypes in Southeast Asia and assess the contribution of these resistant genotypes to SPC. The team also assessed the level and extent of anthelmintic resistance and evaluated the Larval Development Assay (LDA) under tropical conditions in Southeast Asia.

Project outcomes

Development and testing of sustainable integrated strategies for the control of endoparasites

A study was conducted at Babajurang, West Java on the long-term benefits of nutritional supplementation during the wet season with non-medicated urea-molasses blocks (UMB). The UMB was effective in maintaining weight gain during the targeted period of nutritional challenge during the rainy season. Anthelmintic (Valbazen) was administered separately at two-weekly intervals to half the supplemented animals, and to half the non-supplemented controls, resulting in a significant and sustained benefit of about 2.2 kg per head. A key positive feature is that this experiment was carried out on farms, with farmers, which gave villagers regular exposure to improved knowledge and skills and an elevation in social esteem.

The development of Indonesian research capacity was highly significant, involving collaboration between several institutes. The outcomes of this component of the project were incorporated in the planning for International Fund for Agricultural Development (IFAD) activities at Babajurang and other IFAD sites. A survey of the knowledge, attitudes and expectations of 25 farmers provided a valuable starting point for community awareness and involvement in projects. A major impediment to the adoption of this technology is its initial investment cost in a depressed economic environment, which is a major factor in the design of the delivery of the ACIAR project benefits through the IFAD project.

Four studies were also conducted in the Philippines to examine the effects of strategic supplementation of goats in the dry and rainy seasons with urea-molasses blocks containing an anthelmintic (MUMB).

Assessment of the extent of anthelmintic resistance in sheep and goat populations in SE Asia using the Larval Development Assay (LDA)

The LDA has been developed and applied in Philippines and Indonesia with early support from CSIRO and an extensive technical training program. Widespread drench resistance has been identified in the Philippines, highlighting the urgency and importance of reducing the impact of resistance and developing alternative control strategies. This confirms that SPC research initiatives in the current project are immediately relevant in the national interest. This research activity provides a series of examples of good scientific planning, rigour, attention to task, careful management and sharing of resources and responsible administration. Following the inclusion of data for Mindanao and Indonesia the paper will benchmark similar surveys planned in other countries of SE Asia by IFAD. Very little LDA resistance testing has been completed in Indonesia, and more needs to be done.

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

Overseas Collaborating Countries	Indonesia, Bangladesh, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam
Commissioned Organisation	International Centre for Tropical Agriculture, Colombia
Project Leader	Dr Francisco Morales Phone: +57 2 445 0000 x3379 Email: f.morales@cgiar.org
Collaborating Institutions	Department of Agriculture, Thailand Regional Agricultural Research and Development Centre, Sri Lanka CSIRO Plant Industry, Australia Bogor Agricultural University, Indonesia Institute of Agricultural Sciences of South Vietnam, Vietnam CSIRO Entomology, Australia Asian Vegetable Research and Development Centre, Taiwan University of the Philippines at Los Banõs, Philippines Nepal Agricultural Research Council, Nepal Research Institute of Fruit and Vegetables, Vietnam Can Tho University, Vietnam Malaysian Agricultural Research and Development Institute, Malaysia Bangladesh Agricultural Research Institute, Bangladesh
Project Budget	$562,000
Project Duration	01/01/1999 to 31/12/2003 (Project extended from 01/01/2002 to 31/12/2003)
ACIAR Research Program Manager	Dr Paul Ferrar

Project background and objectives

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

Project outcomes

Based on report to December 2002; final report due mid-2004

The overall goal was to identify components for inclusion in a sustainable integrated pest management (IPM) strategy for control of whitefly-transmitted geminiviruses (WTG) and whiteflies on tomato. In Vietnam the collaborating institutions are the Research Institute for Fruit and Vegetables (Hanoi) and Cantho University in southern Vietnam, which agreed to join the project June 2002 so experiments could be conducted in northern and southern Vietnam under diverse environments.

At least four tomato hybrids were identified with relatively high yield potential and good fruit qualities

but their WTG resistance must be confirmed under greater WTG pressure in future trials. Two tomato-infecting WTG from northern and southern Vietnam were sequenced and found to be highly diverse, confirming the need for a WTG IPM strategy including multiple control components. Petroleum oil experiments were not conducted this year due to unfamiliarity with the technology but the experiments have been designed in consultation with Dr. Beattie and will be carried out in early 2003.

Twenty-one tomato entries, including inbred lines and hybrids were evaluated in a preliminary yield trial at the Research Institute of Fruit and Vegetables (RIFAV) from April-June 2002 of eleven plant families. Three hybrids, TLCV1, TLCV2, and TLCV15 yielded significantly more than the other hybrids and produced better fruit quality than inbred lines CLN1621L and CS1. Heavy rains during the trial decimated whitefly numbers and resulted in low WTG incidence. The same trial was repeated at RIFAV August-December 2002 under higher WTG pressure. However, results from both RIFAV and AVRDC indicate that the three hybrids above yield relatively well under high temperatures prevalent during the late dry season–early wet season.

Two genetically distinct tomato-infecting geminiviruses from north and southern Vietnam were isolated, cloned, and sequenced. The virus from north Vietnam is most similar to a geminivirus from Taiwan (88% homology) while the virus from southern Vietnam is a strain of a geminivirus from Thailand. The chances are high that AVRDC-resistant lines will hold up against the virus from northern Vietnam or similar viruses. Reaction of AVRDC resistance to the virus from the south is unknown and needs to be determined. The wide range of genetic diversity among the geminiviruses from Vietnam and other parts of SE Asia emphasises the importance of developing resistant lines carrying multiple resistance genes in order to have effective and durable resistance in the region.

Projects under development

at 30 June 2004

Bilateral

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

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

AS2/2004/005 Improving smallholder crop–livestock systems in eastern Indonesia

CP/2001/047 Diagnosis and management of Blood Disease and other banana diseases in Indonesia and PNG

CP/2003/036 Managing pest fruit flies to increase fruit and vegetable production in Indonesia

CP/2004/034 Diagnosis and management of banana wilt diseases in Indonesia

FIS/2002/075 Application of PCR for improved shrimp health management in India, Thailand and Indonesia

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

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

FIS/2002/076 Land capability assessment and classification for sustainable pond-based aquaculture systems in Indonesia and Australia

FIS/2003/027 Minimising environmental effects of tropical finfish grow-out cages in coastal Indonesia and northern Australia

FST/2003/025 Community partnerships for forestry: Enhancing forestry in eaastern Indonesia and Australia

Multilateral

CIM/2003/066 Enhancing the adoption of improved cassava production and utilisation systems in Indonesia and East Timor

Indonesia consultations

26–27 August 2002

Priorities for collaborative agricultural research between Australia and Indonesia were discussed on 26–27 August 2002 in Jakarta at a consultation between ACIAR and representatives of relevant Government Ministries and Agencies (including the Indonesian Agency for Agricultural Research and Development, Forestry Research and Development Agency, the Agency for Marine and Fisheries Research, the universities, Indonesian Institute of Science (LIPI), the private sector and farmers' associations. Priorities for collaboration in fisheries were agreed at a similar meeting on 29–30 July 2002.

These priorities are not to be considered as officially sanctioned priorities of the Government of Indonesia. They are priorities expressed by participants at the 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 Indonesia. Researchers intending to propose collaborative research projects with Indonesian counterparts for ACIAR support should, in the first instance, approach one of ACIAR's Research Program Managers.

It was agreed to maintain the emphasis of the collaborative program on poverty reduction in Eastern Indonesia. Several overarching issues were identified. Research should contribute to increases in both the productivity and competitiveness of Indonesian agriculture. Project outcomes should aim to increase the use of innovation and technology in rural areas, for example, to drive greater value-addition of Indonesian agricultural products and to develop export markets. Research should assist in increasing farmers' incomes through shifting emphasis from factor-driven production agriculture to the development of integrated agribusinesses. This may require collaborative R&D on industry and trade policies, marketing structures and options, including the interface with post-harvest technological quality. Conservation of the resource base for agriculture will be assisted by research collaboration on aspects of biological security and through research that takes into account the implications of decentralisation for the sustainable management of fisheries, forestry and land resources.

Research projects should be driven by design and implementation processes that include end-users, address their socio-economic situation, and provide for greater information transfer to farmers and other end-users. In Eastern Indonesia there are opportunities to capitalise on linkages between central research institutions and location-specific adaptive research that directly addresses farmers' needs. More follow-up activities that enhance the transfer of technology of earlier ACIAR projects will be pursued, and opportunities for greater involvement of industry explored. Capacity building in research and innovation management, particularly intellectual property, bio-safety and plant variety rights systems will be supported.

Agreed priorities are listed under selected ACIAR program areas.

Agricultural Economics

- Impact of decentralisation on natural resource management and development of better management policies
- Impact of trade agreements on food security and incomes of small producers
- Empowerment of small producers in agribusiness for better access to production factors and market returns
- Structural adjustment options for agribusiness to optimise economic and social benefits)

Animal Sciences

- Development of sustainable crop-livestock systems
- Enhancement of Bali cattle productivity through improved management and genetic improvement
- Management of livestock diseases to improve production and establish market access and trade relationships
- Disease risk assessment and risk management to enhance safety of foods of animal origin

Crop Sciences (emphasis on crop protection)

- Integrated Pest Management, especially in soybean, potato, crucifers and other vegetables
- Rodent pest control, including strategies for management in upland crops as well as paddy rice
- Host plant surveys and pre-harvest control of fruit flies
- Diagnosis and control of phytophthora on citrus rootstocks, potato and pepper
- Management of major pests and diseases of bananas, including Fusarium wilt, blood disease and banana skipper
- Information systems for quarantine, including pest and disease compendia

Fisheries

- Sustainable aquatic farming systems in inland, coastal and marine waters (genetic improvement, disease management, feeds and nutrition) for small and medium enterprises
- Stock assessment and management of shared and common-interest fisheries, including policy level research, IUU fishing issues, and environmentally friendly fishing techniques
- Management of inland open water fisheries including aquaculture
- Improved processing, packaging and transport technologies which extend product life and increase market value

Forestry

- Development and domestication of Eastern Indonesian species for income generation from non-timber forest products
- Species selection and breeding to support plantation development, with emphasis on indigenous species, land rehabilitation and environmental services in Eastern Indonesia
- Development of tree farming (out-grower scheme) models with improved smallholder and plantation company cooperation
- Improved utilisation and value addition of timber from fast growing plantation species

Land and Water Resources Management (emphasis on crop management)

- Improved irrigation efficiency and soil disease management in vegetable cropping systems
- Establishment of prescriptive regional fertilizer recommendations, including for micronutrients
- Application of seasonal climate forecasting for improved crop management
- Efficient water management in Eastern Islands irrigation systems

Postharvest Technology

- Postharvest disinfestation for quarantine
- Postharvest control of mycotoxins in maize, copra and medicinal plants
- Value addition to agricultural products and utilization of by-products, including for animal feed

ACIAR publications

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

Monographs

7 Malignant Catarrhal Fever in Asian Livestock
19 Draught Animal Systems: an Indonesian study
21 The Major Arthropod Pests and Weeds of agriculture in Southeast Asia
22 Food Price Policy in Indonesia
26 Biological Control of Weeds: Southeast Prospects
32 Working with Mycorrhizas in Forestry and Agriculture
34 Breeding for resistance to Infectious Diseases in Small Ruminants
36 Ruminant Nutrition and Production in the Tropics and Subtropics
40 Essential Oils of Tropical *Asteromyrtus, Callistermon* and *Melaleuca* Species
48 Nutrient Disorders of Sweet Potato
51 Biological Control of Insect Pests: Southeast Asian Prospects
52 Improving Smallholder Farming Systems in Imperata Areas of Southeast Asia
54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries*
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) (Bahasa edition available)
74 Nutrient Disorders in Plantation Eucalypts
82 Controlling Newcastle Disease in Village Chickens: A Field Manual*
83 How to Unravel and Solve Soil Fertility Problems*
86 Controlling Newcastle Disease in Village Chickens: A Training Manual*
87 Controlling Newcastle Disease in Village Chickens: A laboratory Manual*
88 Developing forage technologies with smallholder farmers: How to grow, manage and use forages (available from CIAT: www.ciat.cgiar.org/asia) (Bahasa edition available)
94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package*
95 Improving Indonesia's Beef Industry*
96 Rats, Mice and People: Rodent Biology and Management*
97 Effects of Globalisation and Economic Development on the Asian Livestock Sector*
99 Developing agricultural solutions with smallholder farmers (available from CIAT: www.ciat.cgiar.org/asia) (Bahasa edition available)
100 Field methods for rodent studies in Asia and the Indo Pacific*
102 Lantana: Current Management Status and Future Prospects*
108 Pig Husbandry in New Guinea: a literature review and bibliography*

Proceedings

20 Management of Wild and Cultured Sea Bass/Barramundi (Lares calcarifer)
29 Sulfur Fertilizer Policy for Lowland and Upland Cropping Systems in Indonesia
33 Sustainable Agriculture on Marginal Uplands of Southeast Asia
46 Draught Animal Power in the Asian-Australasian Region
51 Foot-and-Mouth Disease in Southeast Asia
59 Fish Drying in Indonesia
61 Agricultural Impacts on Groundwater Quality
63 Matching Trees and Sites
64 Integration of Ruminants into Plantation Systems in Southeast Asia
67 Sugarcane Germplasm Conservation and Exchange
70 Management of Clay Soils for Rainfed Lowland Rice-based Cropping Systems
71 Grain Drying in Asia
74 Sustainable Parasite Control in Small Ruminants

75 Jembrana Disease and the Bovine Lentiviruses
77 Breeding Strategies for Rainfed Lowland Rice in Drought-prone Environments
79 Trochus: Status, Hatchery Practice & Nutrition
86 Leucaena: adaption, quality and farming systems
88 Towards Better Management of Soils Contaminated with Tannery Waste
89 Elimination of Aflatoxin Contamination in Peanut
90 Towards Sustainable Shrimp Culture in Thailand and the Region*
91 Fire Management
93 Integrated Nutrient Management in Farming Systems in Southeast Asia and Australia
94 Classical Swine Fever and Emerging Diseases in Southeast Asia
95 Working with Farmers: The Key to Adoption of Forage Technologies*
100 Quality Assurance in Agricultural Produce*
108 Development Strategies for Genetic Evaluation for Beef Production in Developing Countries*
110 Strategies to Improve Bali Cattle in Eastern Indonesia*
111 Eucalypts in Asia*
112 Breeding for Drought Resistant Peanuts*

Technical reports

18 Post-Flask Management of Tissue-cultured Bananas
22 Plants Fed to Village Ruminants in Indonesia
30 A Review of the Biology and Management of Rodent Pests in Southeast Asia
33 Afforestation of Imperata Grasslands in Indonesia and Australia
51 Heartrots in Plantation Hardwoods in Indonesia and Australia*
53 Cooperatives: Issues and trends in developing countries*
54 Contract farming in Indonesia: Smallholders and agribusiness working together*
55 Chromolaena in the Asia-Pacific Region*

Research Note

26 Non-chemical Control of Rodents in Lowland Irrigated Rice Crops* (available in Bahasa)

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*