

Country Profile

Philippines

October 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 to give a snapshot of the collaborative research being carried out between Australia and our key partner countries. This publication contains short summaries of bilateral and multilateral projects with the Republic of the Philippines that were active at 30 June 2004. At that time there were 20 active bilateral projects and four active multilateral projects, the latter being led by international agricultural research centres. There were another nine bilateral and one multilateral projects under development, many of which are expected to start in 2004–05.

This publication also sets out the key outputs and outcomes from the nine projects (eight bilateral and one multilateral) that have been completed since July 2002.

In addition to these project summaries, the publication includes an extract from ACIAR's 2003–04 Annual Report covering the Philippines, 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 the Philippines on the medium-term priorities for the joint program.

ACIAR will update this profile each year and distribute it to key stakeholders in the Philippines 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 the Philippines. For information on ACIAR's overall program, we invite you to visit our website at www.aciar.gov.au.



Peter Core
Director

September 2004



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Philippines Report 2003–04

(extract from ACIAR Annual Report 2003–04)

Active projects in 2003–04	35
AOP budgeted expenditure in 2003–04	\$1,980,195
Actual bilateral country expenditure in 2003–04	\$1,852,285
Bilateral country expenditure in 2002–03	\$2,948,986
Bilateral country expenditure in 2001–02	\$2,471,426

Key performance indicators	Performance 2003–04
<ul style="list-style-type: none"> New research projects underpinned by design processes that include end-users of the research and address their needs. 	Strong end-user involvement in new Landcare, weed management, groundwater management and mango supply chain projects.
<ul style="list-style-type: none"> At least 400 farmer groups adopting Landcare principles in Mindanao and the Visayas. 	More than 400 Landcare groups, with participation between 25 and 35 per cent of farming households and conservation adoption between 35 and 65 per cent.
<ul style="list-style-type: none"> Diagnostic screening tests for tick-borne diseases applied to screening cattle in at least two provinces. 	Surveys have been conducted in Luzon and in Mindanao.
<ul style="list-style-type: none"> Evidence of community group involvement in watershed management on Bohol Island. 	Local catchment stakeholders and community groups are actively engaged with the project.

Position

ACIAR's program in the Philippines, which commenced in 1983, has a broad aim of supporting improvements in agricultural productivity to increase market access for poorer farmers. A shift in project location, to emphasise poorer areas of Mindanao and the Visayas, reflects this broad aim. Increasingly ACIAR underpins new research projects with design processes that include the end users of the research. Project activities that enhance the impact of earlier ACIAR projects are now a particular focus, as is increasing the sustainability of agriculture and development of the natural resource base.

Achievements

Small ruminant production in the tropics is constrained by parasites, including nematode worms. Chemicals (anthelmintics) have been used to control nematode parasites, but there are concerns over levels of anthelmintic resistance. Surveys revealed **low rates of resistant parasites** and highlighted the need to maintain random surveys as a measure of resistance. Collection of genetic data has been undertaken and a database developed. Guidelines for worm control and husbandry techniques are being disseminated in the Philippines and beyond, in part through a CD-ROM and the Internet.

Surra (trypanosomiasis) caused by *Trypanosoma evansi* is endemic throughout livestock in Southeast Asia. Molecular techniques to improve the diagnosis of *T. evansi* have resulted in a sample test kit for diagnosis being distributed in Mindanao. This will significantly enhance the mobility of surveillance. Evaluation of existing drugs against Surra has determined **which suit large animals**. Investigations into the epidemiology in the Philippines revealed that the combination of buffalo and goats is likely to increase infection. Another project is helping equip the Bureau of Animal Industry with expertise in diagnosing and controlling bovine babesiosis and anaplasmosis. Past project work in Zimbabwe developed ELISA diagnostic tests which are being adapted in a more user-friendly form. Training in the use of the kit and in disease control has also been undertaken.

A database is being compiled for breeding and performance records for ruminant species to **identify elite breeds** for incorporation into a customised version of the Breedplan software, which enables selection of elite genetic lines. It is hoped to emulate the success achieved in Thailand, where the use of Breedplan has led to improvements in the quality of Thai cattle breeds.

The contribution of livestock to the smallholder farming sector is limited, due to poor uptake of research outputs that could boost productivity. The Leyte Livestock Improvement and Innovation Network established under an ACIAR-supported project continues to build smallholder capacity through contacts with local teams of farmers and **linking these, through participatory research, to R&D providers**. Profits of members farming pigs and chickens have increased, and improved environmental management has been achieved. A combined knowledge system—Selection of Forages for the Tropics (SoFT)—for forages suitable for smallholder farming and livestock systems is being developed for several countries. Database specifications have been drawn up and more than 100 forage species reviewed.

Researchers have conducted a survey of smallholder duck and chicken producers to reveal constraints to **improved performance**, with preliminary analysis revealing that marketing systems limit farmer opportunities.

The Landcare program, working in conjunction with a Spanish aid agency on implementing and testing the applicability of the approach in upland farming communities in Mindanao, has had significant impact at its three project sites. More than 400 Landcare groups have been formed with participation by up to 35 per cent of households, **adoption of conservation measures by up to 65 per cent of farmers**, and protection of up to 25 per cent of farmland. The project also had significant impact on both social capital through membership of Landcare groups and farmer knowledge and skills through training provided. Since proving that Landcare is successful in an upland context 45 Local Government Units and Non-Government Agencies and Organisations have now become actively involved, re-shaping institutional approaches to agricultural development. Questions remain on the long-term sustainability of Landcare and how best to extend it beyond the initial pilot sites.

A new project, co-funded by AusAID, has been formulated to address these questions by establishing an independent network of Landcare coordinators and site support personnel at five sites across the southern Philippines. The project will analyse the most appropriate processes for the network to **effectively sustain and grow Landcare** throughout the region. The ultimate aim is to integrate the network into a larger independent and self-sufficient non-government Landcare agency, and to evaluate its performance in sustaining the approach.

Another project is examining the agribusiness supply chain for smallholders in Mindanao. Information to provide a complete picture of the chain has been collected, leading to the development of a farm-household model to determine activities that will optimise profits. Discussions have begun with stakeholders to **foster links of farmers with supermarkets**, including cooperation to meet quality standards. Researchers are also examining the role of government policy in supporting such linkages.

Extensive land clearing leading to environmental degradation has resulted in the need for reforestation. A project focused on Leyte has developed a demonstration seedling farm for forest species, and the **seedlings are now available** for extension activities. This has resulted in increased interest in re-establishing forest areas. Research capacity has improved, with added assistance from a training manual in socioeconomic research methods. Researchers examining the extension services for agriculture in the Philippines have begun gathering information, initially through meetings with key stakeholders.

Incorporation of genes **resistant to papaya ringspot virus** into papaya breeding lines has led to plants that remain free of disease symptoms in field trials alongside infected plants. Glasshouse trials of backcrossed varieties continue to demonstrate resistance, including some crosses with elite Philippine papaya varieties. A separate project is developing papaya varieties with delayed ripening as a means of extending shelf life and marketability.

Two fisheries projects involving the Philippines and Indonesia began during the year. The first is assessing the genetic diversity of wild stocks of the giant freshwater prawn, to help in preserving wild resources and to provide a sounder scientific basis to improve aquaculture breeds. A second project is helping both countries implement Plans of Action to **manage Illegal, Unreported and Unregulated fishing** (IUU), and to work cooperatively to develop a regional IUU Plan of Action in the shared Sulawesi Sea fishing grounds.

The **use of Australian tree species for wood** and other forest products is being supported through seed collection, allowing trials of relevant species in several countries. Advice on silvicultural

practices, provenance selection and seed production was disseminated to relevant project partners. Seed orchards of Australian species in nine countries were surveyed, providing information on yields and the impact of climatic, soil and management factors. In the Philippines **over-exploitation of natural bamboo stands** has seen many lose productivity. Researchers have developed and trialled management practices to improve productivity—including better irrigation, mulching and fertiliser use—with positive results.

Offsite impacts of pesticides applied to field crops have been assessed, leading to the development of risk-based approaches to preserving water quality. Potential risks in a range of catchments and land uses have been assessed, and monitoring programs established. A separate project on **pesticide residues in horticultural produce** is developing protocols on how to apply enzyme bioremediation technology to remove the residues from several crops.

Watershed monitoring in Bohol continues, with assessment of soil erosion from cropping land and measurement of its impacts on the watershed and water quality. These impacts and options for water resource uses have been discussed with stakeholders for **incorporation into planning activities** for sustainable agriculture. Distribution and water capture from major storage facilities on the Inabanga River have also commenced.

A diagnostic key for sweet potato disorders has been produced on CD and a related field guide for diagnosing common problems developed. By specifying symptoms based on the field guide non-related problems are filtered out. The field guide has been distributed, and after further refinement the CD will follow.

For rice a diagnostic key based on all available information on rice disorders has been packaged in both **a web-based and CD-ROM format**. The key allows users to diagnose specific problems based on observed symptoms. Users systematically filter through a variety of possible causal agents until the problem is identified. Information is available for insect pests, plant diseases, nutrient disorders and other causes of rice crop problems.

A project on biofumigation of soils to eradicate soil-borne pathogens is developing management practices to increase the efficacy of the process. These include the use of green manures in combination with specific treatments. **Best bet strategies for biofumigation** have been developed for pest organisms and are being trialled at the commercial farm level.

Philippines Plan 2004–05

(extract from ACIAR Annual Operational Plan 2004–05)

Population	79.9 million
GNI per capita	AUD 1,878

	\$m 2002–03 actual	\$m 2003–04 budget	\$m 2004–05 budget	\$m 2005–06 indicative
Bilateral research expenditure				
Active projects	2.95	1.98	0.85	0.2
Committed funds for new projects			1.54	1.4
Projects under design			0.02	0.1
Available for new projects				0.7–0.9
Total*	2.95	1.98	2.41	2.4–2.6

*Includes AusAID funds as follows: \$0.20 m (2004-05 budget) and \$0.20 m (2005-06 indicative).

Strategy

The underlying aim of ACIAR cooperation is to assist the Philippines to increase the international competitiveness of and market access for Philippine agricultural products, taking into account the impacts of trade liberalisation. Underlying competitiveness is the need to improve agricultural productivity to raise rural incomes through more effective extension of R&D and by responding to market opportunities with higher quality commodities produced at a competitive cost. Specific opportunities may come through research for development and marketing of aquaculture, plant and livestock products, applications of biotechnology for contaminant reduction and quality improvement, and improvements in agricultural systems. Sustainability of agricultural production is a key concern, so research will be targeted to help ensure that improved productivity does not come at the expense of natural resources degradation, especially of uplands and fragile watersheds and coastal zones.

Key performance indicators

- Evidence of strengthening of the interface between research and extension teams in at least four projects
- New natural resource management projects underpinned by design processes that involve end-users of the research and address their needs
- Commencement of two ACIAR/AusAID jointly funded initiatives in response to undertakings made by Prime Minister Howard in July 2003
- Improved tree nursery production practices implemented in private and community nurseries in Leyte
- Prospects for using biofertilisation to reduce pathogen damage to vegetables assessed
- Evaluation of the ripening characteristics of glasshouse-grown genetically modified papaya fruit
- Increased awareness and cooperation on illegal, unreported and unregulated fishing issues at a national policy level
- Evidence of farmer uptake of grouper and mud crab hatchery technologies

Position

ACIAR's program in the Philippines has been active since 1983. Initially the program had several projects dedicated to research on soil management issues — nutrient management, erosion control, rice cropping systems, biological nitrogen fixation and tree establishment on degraded land. Research on postharvest storage of grain was also important. During the 1990s research shifted towards livestock management and biotechnology. A shift in project location, to emphasise the poorer areas of Mindanao and the Visayas, but maintaining strong links to research and development expertise in Manila and Los Banos, will continue.

Uptake of research in the Philippines is a major challenge. There has been limited adoption of technologies developed to reduce loss of grain after harvest and huge potential for future expansion. In recent times there has been encouraging success with the adaptation of the Landcare approach in Mindanao, and in the uptake of methods for successful tree establishment on degraded lands. Scientists have developed experimental hatchery and growout techniques for mud crab culture, and the focus is now on scaling up to commercial levels. Culture success with giant clams, valued as food and for income through the shell trade, has enabled the largest and fastest growing species (*Tridacna gigas*) to be re-established in several areas where the species had become locally extinct.

New research projects should be underpinned by design processes that involve the end-users of the research and address their needs. Project design should also accommodate the additional challenges that have arisen from the devolution of the management and governance of extension responsibilities to local government units, and the comparatively weak research–extension linkages that may currently exist. Opportunities exist for follow-up activities that enhance the impact of earlier ACIAR projects.

One major IARC, the International Rice Research Institute (IRRI), is headquartered in Los Banos, Philippines. ACIAR provides core funding to IRRI and also supports additional initiatives aimed at maintaining rice productivity.

During Prime Minister Howard's July 2003 visit to the Philippines an undertaking was made for closer cooperation on technical assistance in agriculture. ACIAR and AusAID will initiate some jointly funded activities in the Philippines in 2004–05, most likely in the areas of postharvest technology, disinfestation and pest management in fruits and in scaling out of the Landcare approach to farmer-driven natural resource management.

Indicative priorities

ACIAR has a program of consultations with key partner countries on a four-year rolling basis to establish priorities for research collaboration. The most recent such consultation with the Philippines was held in March 2002. In 2004–05, new projects will be considered in the areas of agricultural economics, fisheries, postharvest technology and broad-scale management of land and water resources, with the current priorities in those areas being:

Agricultural economics and development policy

- Analysis and development of market structures to increase smallholder profitability
- International competitiveness and industry policy research for particular Philippine agricultural commodities
- Domestic and international commodity production forecasting, and application of economic modelling of supply and demand
- Public education and policies for application of biotechnology in agriculture
- Economic assessment of the market potential of genetically modified crop products
- Comparative assessment of the efficiency and effectiveness of different models and mechanisms for the delivery of agricultural extension services in the Philippines
- Application of information and mapping systems to assist in agricultural planning and technology localisation
- Valuation of environmental services required for sustainability of agricultural production

Crop protection and postharvest technology

- Application of biotechnologies for the improvement of horticultural crops and coconuts
- Development and application of diagnostic tools for major crop diseases
- Policy and regulatory standards for the management of pesticide residues and mycotoxins
- Optimisation of postharvest systems and equipment to improve utilisation of crops and byproducts
- Development of information modules and training systems to facilitate the uptake of crop production, protection and postharvest technologies

Fisheries

- Development of sustainable coastal aquaculture systems, including the integration of capture fishery and culture systems
- Technologies and policies to meet fishery product quality and food safety requirements of markets
- Development of improved surveillance and management capacity for economically important fisheries diseases
- Consolidation of available fisheries research knowledge for use by smallholders, extensionists and educators

Land and water resources management

- Research to underpin groundwater management policies
- Improved adoption of soil fertility management and soil and water conservation strategies at the watershed level
- Analysis of the impact of fast-growing trees on the availability and quality of water for agriculture
- Technical and economic analysis of the irrigation requirements of high-value fruit and forest tree plantings
- Improved cropping and agroforestry options and land management systems for marginal and hilly lands

Key program managers

Dr Ken Menz, Agricultural Systems Economics and Management

Mr Barney Smith, Fisheries

Dr Ian Willett, Land and Water Resources

Dr Greg Johnson, Postharvest Technology

Country Manager

Ms Cecilia Honrado, ACIAR Country Manager Philippines

Active projects

at 30 June 2004

Bilateral

AS1/2000/009: Development of diagnostic and control methodologies for animal trypanosomiasis (surra) in Papua New Guinea, Indonesia, the Philippines and Australia	17
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Multilateral

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SMCN/1999/003: Integrated nutrient management in tropical cropping systems: Improved capabilities in modelling and recommendations	53

Bilateral

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, PNG 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 yet to be detected in Papua New Guinea 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)

Objective 1: Transfer of existing technologies

A project workshop presenting findings to date was held in Darwin in July 2003 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 Department of Primary Industries. Project outputs were discussed in the context of the priorities of each partner country to identify information and data suitable for dissemination at the smallholder level and for publication.

Objective 2: Application of molecular techniques to improve the accuracy of diagnosis of T. evansi

A prototype sample collection kit has been developed and provided to project participants in Mindanao for evaluation. Veterinary staff members from NAQS have purchased FTA cards for preliminary evaluation in their East Timor program, confirming their suitability for use to collect blood samples for surveillance for surra and other blood-borne infections. The use of 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 to 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.

Objective 3: Determining the 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). These show correlations between differences in the epidemiology of infection in camels and geographic separation in Kenya. 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.

Objective 4: Evaluating the efficacy of existing trypanocidal drugs for the treatment of T. evansi

Four separate experiments were conducted at Balitvet (Indonesia) 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.

Objective 5: 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 model will be used to develop tools and methodologies for the study of the pathogenesis of surra as well as tests to detect infection.

AS2/1998/025: Performance evaluation and genetic improvement of ruminant animals in the Philippines

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	University of New England, Agricultural Business Research Institute, Australia
Project Leader	Mr Arthur Rickards Phone: 02 6773 3555 Email: arthur.rickards@abri.une.edu.au
Collaborating Institutions	Department of Agriculture, Philippines
Project Budget	\$739,284
Project Duration	01/01/2000 to 31/12/2005 (Project extended from 01/01/2003 to 31/12/2005)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

The livestock sector contributes about 28 per cent of income derived from the Philippines agricultural sector. The ruminant sector, comprising buffalo (carabao), cattle and goats, is in much need of improvement. This project is assisting the Philippines to increase the productivity of its ruminant animals through genetic improvement. Significant tasks of the project include the compilation of a national Philippines database containing breeding and performance records for ruminant species, to identify elite performers under Philippine conditions for use in future breeding programs. The scientists are customising Australian BREEDPLAN software for Philippine conditions, and the Australian/Philippine collaboration is increasing the expertise of Filipino scientists to enable them to continue their own genetic evaluation programs.

Project progress

Year 4 (01/01/2003-31/12/2003)

The work in 2003 has continued to focus on electronic capture of breeding and performance records to form databases that could be used in genetic evaluations. Follow-up-training in the use of Herd Magic for data recording was undertaken. Progress was made in capturing data from private farms to supplement that from BAI's research herds.

A project meeting for Filipino participants was convened in July 2003 to focus attention on the work to be undertaken and priorities. Preliminary datasets for beef cattle, Carabao and small ruminants were released to AGBU who characterised the data and made preliminary conclusions on its suitability for parameter estimation. Recommendations on future activities with beef cattle, small ruminants and carabao were agreed upon.

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	University of the Philippines at Los Baños, Philippines Don Mariano Marcos Memorial State University, Philippines Dinas Peternakan Propinisi Dati I, Indonesia National Beekeeping Centre, Perum Perhutani, Indonesia
Project Budget	\$580,206
Project Duration	01/07/2001 to 31/12/2004 (Project extended from 01/07/2004 to 31/12/2004)
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 is developing and testing cheap, effective and appropriate control measures and developing genetic markers to allow the origin of the mites, and bees that spread them, to be identified. The markers will be useful in assisting Philippine and Indonesian authorities in decision-making regarding the feasibility of eradication campaigns and/or the scope of control programs. Australia's capability to deal with future exotic incursions has also been strengthened. Through its various activities the project is generating and supporting 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 per cent 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. This improves FA vapour production, allowing treatments be applied for longer using high concentrations of FA, resulting in longer contact between the FA and mites. 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 diluted 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 collaborating organisations 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 one 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.

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

Overseas Collaborating Countries	Philippines, China, India, Pakistan, South Africa, Vietnam
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. Project research is synthesising and interpreting much of the accumulated information on species adaptation, use and management over the last 50 years from across the tropical world, 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; and (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 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 2002–03 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 2004. The project leader also visited FAO and demonstrated the LUCID SoFT prototype in October 2002.

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

Discussions are 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/1997/041: Enhancing the contribution of livestock within smallholder mixed farming systems in the Philippines

Overseas Collaborating Countries	Philippines
Commissioned Organisation	University of Queensland, Dept of Farm Animal Medicine and Production, Australia
Project Leader	Dr Robert A E Pym Phone: 07 3365 2604 Email: r.pym@mailbox.uq.edu.au
Collaborating Institutions	Leyte State University, Philippines Curtin University of Technology, Australia Queensland Department of Primary Industries and Fisheries, Australia
Project Budget	\$893,746
Project Duration	01/07/2000 to 31/12/2004 (Project extended from 01/01/2003 to 31/12/2004)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

The livestock of smallholder farmers in Leyte, Philippines perform poorly, but farmers have shown reluctance to take up the results of research that could substantially raise productivity. This project is seeking to remove some of those constraints by involving farmer groups in participatory planning and by promoting within the groups improved strategies for livestock and whole-farm management. The project team is assessing current practices and implementing, where appropriate, cost-effective changes in housing, feeding, breeding and waste management. The scientists are also investigating the impact of disease and, where possible, introducing cost-effective interventions. Another study is examining how to optimise the farmers' credit and marketing opportunities. In Australia, the collaborators are seeking to improve extension processes that help Australian pork producers with whole-farm analysis, decision-making and livestock management.

Project progress

Year 3 (01/07/2002-30/06/2003)

The Philippines component of the project, the Leyte Livestock Improvement Program (LLIP), has established a regional improvement and innovation network called the Leyte Improvement and Innovation Network (LIIN). This network is designed to build the infrastructure and capacity required to achieve continuous improvement and innovation of smallholder livestock enterprises in Leyte, now and in the future. The LIIN consists of local teams of farmers with clear roles and focuses for action. The leader of each local team is a member of the LIIN Leadership Team. LLIP and LIIN leaders have been equipped with leadership knowledge and skills through specifically designed training.

The LIIN Leadership Team works in partnership with the LLIP leadership and project staff to design and manage R&D services to achieve 5 per cent improvements in profit, environment and efficiency each year. The LIIN Leadership Team negotiates service delivery from other service providers (e.g. Local Government and other organisations).

All LLIP Philippine Project staff have achieved accreditation in the University of Queensland's *Continuous Improvement and Innovation* course offered by the Centre for Rural and Regional Innovation. It was a LLIP goal to build the capacity of Philippines R&D personnel and agencies to achieve continuous improvement and innovation of participative R&D. The level of performance achieved is outstanding by Australian standards.

All Philippines project staff and two of the LLIP farmer partners completed the *Improving R&D Outcomes in Rural and Regional Agricultural Systems* program which was designed to build the capacity of participants to improve outcomes in current and future R&D programs.

The LIIN in partnership with the LLIP ran a regional, national and international *Profit and Environment Improvement Workshop*. The focus of this workshop is on achieving improved capacity for sustained improvement of smallholder profit and environment.

In preparation for the LIIN Profit and Environment Improvement Workshop, the capacity of LLIP staff and LIIN leaders and farmers has been developed to:

1. Design and lead a regional, national and international workshop
2. Prepare and deliver high quality reports
3. Support reporting for improvement and innovation.

All LLIP staff have produced and delivered scientific publications of their individual work. This process of encouragement and support for individual publications has had considerable impact on individual, team and LLIP performance.

A Pig Environment and Efficiency Improvement System has been developed for improving pig enterprise environment and energy efficiency. Specific environment and energy efficiency Performance Management Frameworks have been developed to focus on the critical success factors (CSFs) and Key Performance Indicators (KPIs) of environment and energy efficiency. This system is based on bio-digester technology and is being adopted within the LIIN and promoted and adopted throughout Leyte and other regions in the Philippines. The LLIP and LIIN leadership are partners in the R&D, marketing and delivery of the system as a service.

A Pig Profit Improvement Process has been developed which is focused on achieving improved gross margins of smallholder pig enterprises. The process uses a Performance Management Framework and KPIs to focus thinking, action and technologies on improving pig gross margins. This process is being adopted in LIIN and is being used in partnership with other service providers in the region.

A Chicken Profit Improvement Process has been developed which is focussed on improving gross margins of smallholder chicken enterprises. The process takes into account the benefits and costs of meeting smallholder family protein needs from eggs and chickens.

A bio-economic model of smallholder chicken production has been developed by LLIP staff. This model will enable technologies to be assessed for impact on profit before they are promoted to poor smallholders.

A Pig and Chicken Input and Output Management and Marketing System has been developed which has contributed to improving gross margins of LIIN members. A Pig and Chicken Production and Profit Information System has developed information about regional production and profit benchmarks, and the performance of LLIP R&D services in improving LIIN members profit, environment and efficiency. All LLIP staff and the LIIN Leadership Team attended the World Poultry Congress and the International Workshop on Improving R&D Outcomes in Rural and Regional Agricultural Systems.

ASEM/2000/088: Redevelopment of a timber industry following extensive land clearing

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	University of Queensland, School of Natural and Rural Systems Management, Australia
Project Leader	Dr John Herbohn Phone: 07 5460 1646 Email: john.herbohn@uqg.uq.edu.au
Collaborating Institutions	Leyte State University, Philippines Southern Cross University, Australia
Project Budget	\$398,911
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Previous research in the Philippines and north Queensland has focused on site–species matching studies, with little consideration of the appropriateness of, and constraints to, non-industrial forestry in a wider social and economic context. Availability of species that are suitable for a particular site is only one of many factors influencing the uptake of non-industrial forestry. This project addresses the problem of slow uptake of farm and community forestry in the Philippines and north Queensland, in the presence of apparently suitable technology, and in the light of the substantial socio-economic and environmental benefits to be gained from increased reforestation. The project is determining the support measures needed to promote non-industrial forestry in Leyte province, and developing a structured methodology that will lead to more rapid adoption of non-industrial forestry in other regions in the Philippines. It is also examining the potential for re-establishment of a rainforest cabinet timber industry on the Atherton Tablelands of north Queensland.

Project Progress

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

The project made significant progress towards completing the scheduled project activities during 2003. The project involves a series of interrelated studies, viz: a survey of smallholder households in four community; an investigation of the role and effectiveness of people's organisations in facilitating community forestry; a study on the reasons why microfinancing of tree farms has failed; research into nursery production technologies and field trials; a survey of nursery operators; a study on carbon sequestration potential of smallholder forest plots; timber supply and demand studies; and the estimation of financial returns from forestry. Data collection and analysis was largely completed for each of the studies conducted as part of the project.

ASEM/2000/101: Improving the efficiency of the agribusiness supply chain and quality management for small agricultural producers in Mindanao

Overseas Collaborating Countries	Philippines
Commissioned Organisation	Curtin University of Technology, Muresk 'Agribusiness' Institution, Australia
Project Leader	Roy Murray-Prior Phone: (08) 9690-1595 Email: R.Murray-Prior@curtin.edu.au http://www.curtin.edu.au/curtin/muresk/aciarmindanao/
Collaborating Institutions	University of the Philippines, Mindanao, Philippines
Project Budget	\$342,614
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/07/2003 to 31/12/2004)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

This project is examining the factors that affect the performance of the agribusiness supply chain for selected fresh vegetables produced by smallholders in Mindanao, Philippines, with particular emphasis on the potential for farmer cooperatives to perform the agribusiness functions and deliver greater benefits to the farmer. The project involves rapid appraisal and case study methods to assess the performance of the current marketing arrangements, and is identifying impediments to the functioning of the supply chain. The researchers aim to determine whether there is adequate information flow between market intermediaries and the farmer, to reflect the market requirements for quality management. Training programs, workshops and seminars with farmer groups and institutional participants are being used to facilitate the adoption of quality management systems and improve the success rates among agricultural cooperative groups.

Project Progress

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

Objective 1: Understand the systems small farmers in Mindanao employ to produce and market selected fresh vegetables

Farm-household and downstream surveys were used to collect information & data on: socio-demographic profiles; farmer production, harvest, marketing, post-harvest management systems; distribution and logistics systems; financial, credit, input and information flows along the supply chain; and product quality. To support this case studies and associated soil analyses were used to: describe the existing production practices for vegetable crops; relate these practices to productivity and profitability of vegetable farming; evaluate the suitability of production practices from a scientific perspective; and recommend sustainable production practices and policies to encourage these. Data from the farm-household and downstream surveys were also used for the farm-household model, which was then used to determine the optimum mix of activities at the farm level as well as identify the most profitable chain for farmers.

Objective 2: Examine the efficiency of the agribusiness supply chain for selected fresh vegetables in Mindanao

Drawing on the survey information mentioned above, analyses were conducted of the efficiency of the Kapatagan vegetable supply chain. Impediments to the operation of a more efficient supply chain and marketing margins across the supply chain for selected fresh vegetables were examined to analyse factors that affect marketing margins and determine price transmission policy implications.

Objective 3: Identify the extent to which small farmers are able to meet and satisfy the needs of market intermediaries and the extent to which market intermediaries are able to meet and satisfy the farmers' needs and to facilitate the flow of timely market information in the supply chain.

Farm-household and downstream surveys mentioned above were used to collect information and data on: criteria used by farmers and market intermediaries in choosing trading partners. Other criteria included the importance of the product offer and quality dimensions. The importance of long-term buyer seller relationships, the mode, frequency and content of communication between farmers and market intermediaries were revealed along with the value of accuracy and timeliness of market information along the supply chain.

Objective 5: Facilitate the establishment, maintenance and management of quality management systems

Members of the project believe that the greatest gains in welfare for stakeholders in the Kapatagan vegetable supply chain will occur when they are able to develop linkages with supermarkets to establish new quality chains. Supermarkets are able to set and enforce quality standards and extract premiums for quality product that would be extremely difficult for small farmers acting on their own, or even when organised as a cooperative. To this end discussions have begun with the Mindanao Business Council, VICSMIN (Vegetable Industry Council of Southern Mindanao), KALIDECO (Kapatagan Livelihood Development Cooperative), and Kapatagan farmers about the possibilities for cooperation along these lines.

Objective 6: Suggest to government and other interested agencies, appropriate policies and strategies to reduce the impediments in the operation of an efficient supply chain

A number of steps have been taken to implement this objective. These include:

- Linkages developed by UP Mindanao with the Department of Agriculture, the Growth with Equity in Mindanao Project (USAID), Philippine Institute for Development Studies, Vegetable Industry Council of Southern Mindanao and KALIDECO
- Support and major participant in the 1st Mindanao Policy Review Forum, Davao, in June 2003, a forum aimed at identifying possible policy recommendations for the agriculture sector
- Policy document presented at the Fifth Mindanao Food Congress and to be taken up by Department of Agriculture Sec. Luis Lorenzo
- Presented research results to farmers in Kapatagan to gather suggestions from them on policy recommendations they feel would work best in their reality.
- Presented the SEARCA Forum, Los Baños in November 2003 on: 'Towards a more efficient vegetable supply chain: prospects and challenges (a policy forum).

ASEM/2000/107: Future prospects for smallholder poultry producers in the Philippines: ducks and native chickens

Overseas Collaborating Countries	Philippines
Commissioned Organisation	University of New England, School of Agricultural & Resource Economics, Australia
Project Leader	Ms Christie Chang Phone: 02 6773 2855 Email: hchang@metz.une.edu.au
Collaborating Institutions	University of the Philippines at Los Banos, Institute of Animal Science, Philippines
Project Budget	\$235,789
Project Duration	01/01/2002 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Trade liberalisation and market globalisation is occurring worldwide, primarily because of the World Trade Organisation (WTO) agreements among member countries, including the Philippines. This project is investigating whether smallholder producers of poultry (mainly ducks and native chickens) in the Philippines can withstand the effects of trade liberalisation and market globalisation. Although the current production and marketing systems associated with smallholders are under-developed and less efficient in comparison with the commercial broiler and layer chickens, there are strong consumer preferences for ducks and native chickens because of their freshness and unique tastes. Researchers are examining the differences in production and marketing systems of the various Philippine poultry subsectors to identify constraints to, and opportunities for, improving the performance of smallholder poultry production. They aim to provide information and analysis on the structure of the entire supply chains of the subsectors—input supply, farm production, processing and manufacturing, and wholesaling and retailing. The outputs are intended to be used to assess the relative competitiveness and the likely future directions of the Philippine poultry subsectors and the likely impact of WTO on smallholder poultry production.

Project progress

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

Objective 1: Overview of the Philippine poultry production

The draft document of the 'Overview of the Philippine poultry industry' has undergone several revisions as new data and more information become available.

Objective 2: Collection and analysis of farm survey data

Survey questionnaires were administered in six provinces identified as project sites, Quezon, Pampanga, Iloilo, Nueva Ecija, and Batangas. A total of 248 native chicken raisers (in Quezon, Iloilo, Batangas) and 245 duck raisers (in Quezon, Pampanga, and Nueva Ecija) were interviewed with staff of the Provincial Veterinary Offices and Local Government Units particularly the Livestock Inspectors and Agricultural Technicians acting as guides and enumerators. Half-day trainings were conducted in each of the project sites to ensure a good understanding of the objectives of the project and the type of data/information to be collected. The project staff acted as facilitators in these training sessions.

During the survey, the project staff also collected relevant secondary information as well as coordinated the conduct of the data collection. After the survey the questionnaires were edited and data encoded. Microsoft Access database software, was used for data entry and retrieval. The project team contracted the Bureau of Agricultural Statistics to include a one-page questionnaire in their National Poultry and Livestock Survey. The survey was conducted in August 2003. A total of 4,015 questionnaires were administered by the Bureau, with this data still being edited and encoded.

Objective 3: Marketing analysis

To date, 14 native chicken and 7 duck traders have been interviewed to learn more about the marketing system for ducks and native chickens. Later, interviews of key players in the industry will be undertaken to get a better understanding of the important issues facing the industry.

Objective 4: Comparative analysis

International competitiveness of the Philippine poultry industry against the world standards is being reviewed based on exiting literature. Productivity analysis of the duck and native chicken farms will begin as soon as the coding of the survey data is completed.

ASEM/2001/108: Improving delivery of extension services in the Philippines

Overseas Collaborating Countries	Philippines
Commissioned Organisation	Centre for International Economics, Australia
Project Leader	Mr Sandy Cuthbertson Phone: 02 6248 6699 Email: scuthbertson@intecon.com.au
Collaborating Institutions	University of the Philippines, Center for Local and Regional Governance, Philippines
Project Budget	\$398,278
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

In the Philippines, agricultural productivity improvements since the 1960s have been slow in coming. The public delivery of extension services has largely devolved to provinces, cities, municipalities and villages as a result of the 1991 Devolution of Powers Act. Thus, answers to questions of the relative roles of private and public extension services and the financing and delivery of public extension are important. Project researchers are helping to answer these questions by defining the respective roles of public and private extension services in the Philippines. This includes the development of an economic framework for the financing, design and delivery of public extension services to farmers from central to local government level. Practical steps for adopting such a framework will then be proposed.

Project progress

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

Objective 1: Describe and analyse the existing supply chain for the delivery of public extension services.

The activities completed fall into four components. The first was a visit to Los Banos to meet a large group of mayors and vice mayors who were attending a governance workshop. Discussions on the project and agricultural extension services were held.

The second component was a two-day visit to Leyte Province. This involved:

- meeting the provincial agriculturist and the vice governor;
- site visits to various experimentation sites;
- one day workshop with provincial and municipal agricultural officers.

The third component was a visit to the municipal of Santiago in the province of Isabella, for productive and informative meetings with Mayor Miranda and a one day workshop with municipal extension staff and half a dozen farmers. Some extension methodologies were discussed with feedback helping create a fuller picture of the current situation.

The fourth component involved a meeting with the Steering Committee to discuss a proposed program and findings to date.

Objective 2: Design an economic framework for the financing, design and delivery of public extension services to farmers from central to local government level.

A body of research literature, including work conducted by international agencies in recent years, has been compiled.

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, Australia
Project Leader	Dr Steve Adkins Phone: 07 3365 2072 Email: s.adkins@mailbox.uq.edu.au
Collaborating Institutions	Philippine Coconut Authority, Philippines University of the Philippines at Los Banos, Philippines Cocoa and Coconut Research Institute, PNG Research Institute for Coconut Palms, Indonesia 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 Piggitt

Project background and objectives

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

Project progress

Year 1 (01/07/2002–30/06/2003)

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

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

- The first coconut seedlings, following embryo transplantation, have been successfully produced in the glasshouse. The transplantation technique used still requires improvements and is the subject of overseas collaborative work with the partners.
- Large numbers of zygotic embryos have been imported from the Philippines. They have been germinated *in vitro* and are being used to investigate improved methods of seedling growth, development and establishment. This work at UQ plans to examine the use of CO₂ enrichment for improved plantlet formation and greater soil survival.
- The UQ researchers have adapted their somatic embryogenesis protocol, previously developed for zygotic tissue explants, and are using it on explants from imported inflorescence tissues. The procedure showed a very low efficiency rate; medium additives such as coconut water and lauric acid improved the rate of success but no significant results have been achieved. From other studies, preliminary results indicate that abscisic acid (ABA) could improve the development of somatic embryos from inflorescence tissues.

- A protocol for DNA extraction and purification has been optimised for coconut tissues. Good visualisation of DNA can be obtained using approximately 15 to 20 ng of DNA per reaction. Other DNA samples have been imported from Centro de Investigacion Cientifica de Yucatan (CICY), Mexico, and are being analysed for the methylation polymorphisms that may exist between clones.
- The team at UQ hosted a meeting in March 2003 to launch a book published by ACIAR. Titled 'The Coconut Odyssey: The bounteous possibilities of the tree of life', it was written by Mr Mike Foale, CSIRO, an associate member of the UQ team.

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

- The early studies undertaken include those manipulating the culture medium to aid root system development, for producing a good shoot mass to root mass ratio, and those aiming to develop better acclimatisation steps. The germinating embryos, presently being established, take up to one year before they can be used in such experimentation. Therefore, the results will only become available in the second and third years of the project.
- In PNG, work on embryo quality has just been started while one partner in the Philippines has initiated work on somatic embryogenesis.
- Meetings at the collaborating partners' laboratories (PNG, Vietnam and the Philippines) have been undertaken to sharpen the focus of the project program.
- A new internet discussion group 'ACIAR coconut' has been established to facilitate information exchange among the team members involved in the project.

CIM/2001/049: Development of PRSV-P resistant papaya genotypes by introgression of genes from wild *Carica* species

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	Griffith University, School of Biomolecular and Biomedical Science, Australia
Project Leader	Dr Rod Drew Phone: 07 38757292 Email: R.Drew@mailbox.gu.edu.au
Collaborating Institutions	University of the Philippines at Los Banos, Institute of Plant Breeding, Philippines Bureau of Plant Industry, Department of Agriculture, Philippines
Project Budget	\$399,974
Project Duration	01/01/2002 to 31/12/2005 (Project extended from 01/01/2005 to 31/12/2005)
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

Papaya ringspot virus (PRSV-P), the major disease of papaya worldwide, has devastated papaya production in some regions on the island of Luzon, and has also spread to other islands where papaws are produced. In Australia, PRSV-P represents a severe threat to the industry in north Queensland. There is no useful resistance to the disease within *Carica papaya*, and resistance needs to come from production of resistant genotypes. This project follows on from the success of earlier research, which developed fertile, PRSV-P resistant plants through hybridisation between *Carica papaya* and *Carica quercifolia* and the successful backcross from this hybrid to *C. papaya*. Scientists are continuing to backcross the PRSV-P resistant genes to elite *papaya* genotypes in both Australia and the Philippines, and to produce and screen other promising lines in both countries. They aim to develop a DNA marker for virus resistance to facilitate selection of resistant plants in the early seedling stage, and also to evaluate elite resistant papaya lines on grower properties. Scientists expect to produce elite papaya genotypes that are PRSV-P resistant, and plan to trial any genotypes with commercial potential on growers' properties in both countries by the third year of the project.

Project progress

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

Subproject 1: Incorporation of PRSV-P resistance genes into elite papaya genotypes, using fertile resistant backcross plants

Australia: A fertile PRSV-P resistant plant was produced in a previous project when a *C. papaya* x *C. quercifolia* hybrid was backcrossed to *C. papaya* clone 2.001. This plant is numbered clone 54 for ease of identification. Second generation backcross plants (BC2) from *V. quercifolia* have been produced when 54 was crossed with 4 papaya lines. These second-generation backcross plants are being screened for virus resistance both in Australia and the Philippines

Philippines: Clone 54 and seed of these crosses were sent to the Philippines. Both 54 and all the backcross plants were susceptible to PRSV-P in Los Banos however there was variation in symptom expression. The fertile PRSV-P resistant plant clone 54 succumbed to PRSV-P two months after transplanting in the field, with symptoms ranging from chlorotic leaves to oily streaks on the trunk.

Subproject 2: Selection of backcross generations for PRSV-P resistance and good agronomic trait.

Australia: Of the first 200 backcross (BC2) plants screened in Queensland (a backcross generation between clone 54 and papaya line 16), 26 remained symptomless after 5 manual inoculations of virus in a glasshouse. All control plants produced PRSV-P symptoms after 2 inoculations. These 26 plants were planted in the field in the presence of heavy PRSV-P infection. After 8 months, one male and one female plant remain symptomless. The other 26 vary in symptom expression from severe to mild

symptoms of PRSV-P. More recently, more second-generation backcross plants have been planted in the glasshouse at GU and inoculated with PRSV-P. They represent 120 plants of 54 backcrossed to Solo, 60 of 54 backcrossed to GD319-2 (from North Queensland) and 70 plants of 54 backcrossed to papaya clone 2.001. It is too early for symptom development at this stage. To determine agronomic traits of backcross plants, 1 row (34 plants) of 54 crossed to 2.001 and 1 row of 54 crossed to Solo have been planted in the field in Southeast Queensland.

Philippines: Three BC2 populations (2.001 x 54, Sunrise Solo x 54, and GD 319-2 x 54) were planted in Mainit experimental station to evaluate the reaction of the segregating populations against PRSV-P. Symptom expression was observed two weeks after artificial inoculation. Symptom expression of ringspot disease varies in terms of onset of disease and severity of infection in each plant. Another batch of the same BC2 generations were evaluated in the glasshouse. One hundred ninety five BC2 generation between clone 54 and papaya line 2.001, 36 BC2 generation between line 54 and line GD 319-2 and 26 BC2 generation between line 54 and Sunrise Solo papaya were grown in the glasshouse at IPB. The plants were manually inoculated with PRSV-P. From the first inoculation, 74 of BC2 2.001 x 54 plants, 10 of BC2 GD 319-2 x 54 plants and two of Sunrise Solo x 54 plants remained free of symptoms and no virus has been detected by ELISA. Virus infected all control and susceptible plants two weeks after inoculation.

Subproject 3: Backcross fertile resistant C. papaya x C. quercifolia F1 hybrids to C. papaya

Australia: Of the large number of F1 hybrids between *C. papaya* x *C. quercifolia*, generated in a previous ACIAR project (CS1/1991/007), 5 were identified as being PRSV-P resistant and having some pollen fertility. These have been given the clone numbers 401,410, 468 [parent of 54], 469 and 507. Pollen from these hybrids has been used to pollinate female flowers of *C. papaya* clone 2.001 and other *C. papaya* varieties in Southeast Queensland. Seeds from 1077 fruit (from 1302 crosses) of *C. papaya* clone 2.001 have been dissected. From these 1077 fruit, 35,626 seed have been dissected and 185 embryos cultured in vitro. Of these, 131 have produced plants and they will be tested for resistance to PRSV-P next year.

Philippines: Four susceptible IPB inbred lines (4108, 4172, 5648 and 5893) as females and resistant F1 interspecific hybrid lines 410 and 401 as males were used in the backcrossing program to transfer PRSV resistance from *Carica quercifolia* to elite Philippines papaya genotypes. A total of 280 fruits were harvested from crosses generated using these inbred and F1 hybrid lines. Majority of the fruits came from 5648 (154) and 5893 (76) while the least number came from 4108 (30) and 4172 (20). Ninety to 120 day –old fruits were harvested for embryo rescue and culture. A total of 41, 553 seeds were dissected from the different crosses. Inbred 5648 produced the highest seed number of 20,395 but despite these number of seeds only 99 embryos were rescued. Ten well developed embryos were recovered from 10,877 seeds involving inbred line 5893. Twenty six embryos were rescued from 160 seeds involving inbred line 4108. On the other hand, inbred line 4172 produced only 15 seeds, however despite this number eight fully developed embryos were recovered. From the 143 embryos that were rescued from the different crosses, 90 embryos developed into plantlets and are now being maintained in the laboratory.

Subproject 4: Development of molecular markers for PRSV-P resistance

We decided to work initially on the *C. pubescens* x *C. parviflora* population as we have produced a large F2 population (300 plants in the glasshouse) that is segregating for resistance to PRSV-P. Good progress has been made on mapping of *V. pubescens* and *V. parviflora* using RAF markers. A genetic map of the two species has been developed. In recent research on a F2 population that is segregating for virus resistance, 5 molecular markers have been linked to PRSV-P resistance. Two of these, one each side of the gene are being sequenced.

Subproject 5: Micropropagation of elite papaya genotypes

Clones of all *C. papaya* genotypes, fertile resistant *C. papaya* x *C. quercifolia* hybrids, and some backcross plants (including 54) are being maintained in vitro. Plants obtained from the 131 backcross embryos (reported under objective 3) are being multiplied in Australia. In the Philippines, clones of fertile resistant *C. papaya* x *C. quercifolia* hybrids and backcross plants which were embryo rescued are being maintained in vitro.

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 FAO 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 September 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. The 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 is due in September 2004.

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 website	http://www.ffp.csiro.au
Project Budget	\$2,094,461
Project Duration	01/01/2000 to 30/06/2004 (Extension pending)
ACIAR Research Program Manager	Dr Russell Haines

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)

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 crassicaarpa*, *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/2000/127: Improving and maintaining productivity of bamboo for quality timber and shoots in Australia and the Philippines

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	Central Queensland University, Primary Industries Research Centre, Australia
Project Leader	Professor David Midmore Phone: 07 4930 9770 Email: d.midmore@cqu.edu.au http://www.ahs.cqu.edu.au/info/science/psg/research/bamboo/
Collaborating Institutions	Parks and Wildlife Commission of the Northern Territory, Australia Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Philippines Department of Business, Industry and Resource Development, Northern Territory, Australia
Project Budget	\$399,479
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

This project addresses the need to develop better management practices for natural stands of bamboo in the Philippines - many of which have suffered inappropriate exploitation with consequent loss of productivity. The emphasis is on managing for timber and edible shoot production. The work is also developing sustainable cultivation methods for high productivity bamboo plantations being established in Australia. Research to improve the efficiency of the bamboo timber harvesting process, and an assessment of the potential of bamboo for carbon sequestration and pulp production, is also being undertaken.

Project progress

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

Objective 1: Rehabilitation of existing degenerated stands for production of shoots and timber

In the Philippines, the 2003 shoot season was the third since experimental treatments were applied in June 2001. The data gathered to date are only indicative of the initial effects of the treatments, showing trends of increased shoot production in treatments where clump thinning, fertiliser, mulching and irrigation have been applied, singly or in combination, as compared to unmanaged control treatments. At the Burgos, Ilocos Norte site pole and clump productivity greatly improved indicating the effects of the treatments. The number of shoots left to grow as poles significantly affected the diameter of poles and number of shoots produced per clump. For the experiment in Sta Barbara, Iloilo, statistical analyses made on shoot production and shoot yield indicated no significant difference between treatments applied, though the highest number of shoots was noted under Treatment 5 (Farmer's practice). For the experiment at Impalutao, Impasugong, Bukidnon, the data so far did not show any clear trend regarding shoot production. Statistical analysis of shoot production data did not show significant differences among treatment means.

Objective 2: Maintenance of high productivity of existing plantations for shoot and timber

The effects of irrigation, cleaning, and fertiliser application in shoot production were not significant but the clumps that received irrigation and fertiliser application had more shoots than those without irrigation and fertiliser. To further verify the effects of the treatments, the number of poles per clump was considered to determine the productivity per clump. The clump productiveness is measured as the Productivity Index (PI). Irrigated clumps with fertiliser, organic matter/mulch application, and with less than or equal to 4-4-4 poles per clump had a significantly higher productivity index indicating

clumps can be made productive by limiting the number of poles per clump. In 2002, 95 per cent of the 1-year and 2-year-old poles produced shoots which indicate that the 3-year-old poles are not worthy of keeping for shoot production. The height and diameter development of the poles were measured from shoot stage until the first branch was fully developed. New poles reached their full heights in less than two months. The diameter but not the heights of the poles responded to the treatments.

Analysis of variance of the data gathered on culm production in Dumarao indicated significant differences between treatment means at 1 per cent level. The results however were attributed to the big disparity in the number of culms for Treatment 12 (Control) compared to all other treatments. The 2003 cumulative data on shoot production show an increasing trend for the year covering 2002–2003. The analysis of variance showed significant difference between treatment means at 1 per cent level, hence, differences in the number of shoots produced and the increasing trend may be attributed to the treatments applied. Relating the different variables of the treatments applied (particularly on irrigation and harvesting), with particular reference to the harvesting/cutting cycle, the results are not yet conclusive to recommend which treatment or practice is most appropriate in improving productivity of bamboo clumps in a plantation.

In the Northern Territory research work has been discontinued at the Bamboo Planet Earth site due to withdrawal of the owner from the project and the upcoming sale of the property. Experiments are now confined to *D. latiflorus*. Experiment activities continued at the other two sites. Experimental activities continued at the Eumundi, Queensland site, including culm harvest in July 2003, measurement of photosynthesis rates, and investigation of the use of the Minolta SPAD chlorophyll meter for monitoring leaf plant nitrogen status. SPAD measurements were also collected for the NT sites.

Objective 3: Improvement of bamboo timber harvest efficiency and quality

Mean anatomical, chemical, physical and mechanical property data were recorded from *B. blumeana* (Kawayan tinik) culms collected from the MMSU experiment in Batac, Ilocos Norte. The highest relative density (RD) was observed on culms under treatment 12 (cleaning only, no irrigation, mulch, organic matter and fertiliser) and on culms under treatment 2 (dry-no irrigation with mulch, organic matter and fertiliser) with one year and two years silvicultural treatments, respectively.

Objective 4: Market Potentials of bamboo Shoots and Engineered Bamboo

Three regions representing areas where bamboo is widely found [i.e. Region 6 (Iloilo), Region 10 (Cagayan de Oro, Bukidnon), and Region 11 (Davao City, Davao Oriental Compostella Valley)] were visited. Eleven market vendors were interviewed (for market potentials of bamboo shoots) in different wet markets of the three regions. Company owners/bamboo product manufacturers were interviewed for engineered bamboo and other bamboo products. Three informants from the research sector were also interviewed regarding the potentials of bamboo for shoots and engineered products.

Objective 5: Existing and potential demand for bamboo

Bamboo shoots found in the respective wet markets of the three regions were sold to restaurant owners/managers and households. *Bambusa blumeana* (kawayan tinik) was generally sold in the three regions, while giant bamboo was also sold in the markets of Region 10. Other species of bamboo were also sold in relatively less quantity. The price of bamboo shoots tended to be more expensive during lean months when supply is less. The average buying price of the market vendors from the bamboo shoot growers/harvesters was P13.10 per kg during lean months while only P9.62 per kg is paid during peak months. Several factors (i.e. availability of bamboo areas; technology; perishability; preference of poles over bamboo shoots in plantation development and maintenance of natural stands; favourable environment for growth; season of the year and favourable policy environment) were noted affecting the availability or supply of bamboo shoots. The taste and preference of consumers and sustainability of supply affect the acceptability of bamboo shoots in the market. The prevailing price and availability of other vegetable alternatives or substitutes also affect bamboo shoot acceptability.

Objective 6: Existing and potential demand for engineered bamboo and other bamboo products

Interviews with several owners/bamboo product manufacturers and companies in various parts of the Philippines (particularly in Regions 1, 3, 6 and 10) were conducted. Most of the respondents believe that engineered bamboo products have a good potential in the market in the furniture and construction sectors.

LWR/2000/084: Minimising the off-site impact of pesticides from agricultural systems—a risk based approach

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Rai Kookana Phone: 08 8303 8450 Email: Rai.Kookana@csiro.au
Collaborating Institutions	University of the Philippines at Los Banos, Philippines CSIRO Mathematical and Information Sciences, Australia
Project Budget	\$399,888
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

The project aims to develop modern risk-based approaches for reducing off-site impacts of pesticides applied to field crops, in order to protect human health, fisheries and aquatic ecosystems. This involves integrating information on pesticide use, site conditions, and the environmental fate and behaviour of pesticides in selected catchments in the Philippines and Australia. Scientists are carrying out a risk assessment of off-site impacts of agricultural systems, using tools such as CSIRO's Pesticide Impact Rating Index (PIRI), to enable integration of factors to provide outputs that can be easily used by water resource managers, policy makers and community organisations.

Project progress

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

The project has made significant progress towards extending a risk-based approach to stakeholders in the Philippines and Australia to minimise off-site impacts of pesticides on water quality. The stakeholders involved in the project include natural resource managers (e.g. Laguna Lake Development Authority, Ord Land and Water Inc.), regulators (Fertiliser and Pesticide Authority of the Philippines; Water and Rivers Commission of Western Australia) growers, and other stakeholders (e.g. Philippines Council for Agriculture, Forestry and Natural Resources Research and Development).

Recognising the importance of continuous engagement of stakeholders in the project, two stakeholders workshops were held in the Philippines during the year (March and August 2003). The March communication workshop was organised to share the progress of the project and enhance a two-way communication between the project staff and the stakeholders. An additional training workshop was conducted in August 2003 to train staff from several different agencies on the use of the Pesticide Impact Rating Index (PIRI). Similarly, in Australia, a communication workshop was held with growers in the Ord River Irrigation Area in March 2003. A hands-on training workshop on PIRI was held in Adelaide in August 2003. A highly positive feedback was received from the participants.

Philippines scientists assessed the potential risks of pesticides in a range of land uses in the sub-catchments of Laguna and Taal Lakes, using the customised version of PIRI. The pesticides identified to present significant potential risks were included in the monitoring programs (involving samples of water, sediment and aquatic fauna). Occasionally residues at trace level concentrations of pyrethrin insecticides (cypermethrin, deltamethrin, lambda cyhalothrin) organophosphate insecticides (triazophos, methamidophos) and herbicides (diuron, butachlor) have been detected in water and sediments. The relationship of these with PIRI assessments is being investigated.

In Australia, the study-sites cover temperate (Sixth Creek sub-catchment) and tropical climatic zones (Ord River Irrigation area). Following PIRI assessments, monitoring of pesticide residues has been carried out at these sites. In the Sixth Creek sub-catchment simazine, carbaryl, chlorpyrifos and

endosulfan were detected in some sediment samples. These were generally consistent with the mobility rating provided to pesticides by PIRI. In the Ord River Irrigation Area, risk assessment by PIRI lead to identification of pesticides that need to be targeted for on-farm management. An option paper was prepared and discussed with the growers. This results in identification of grower-preferred management options for trial and demonstration, with these trials now underway.

For the groundwater component of PIRI assessment, instrumented lysimeters were used. Drainage through these lysimeters occurred, from September 2003 onwards after no drainage for two years. The water samples are in the process of being analysed for pesticides.

To generate relevant environmental fate and ecotoxicological data for improved risk assessment, the laboratory experiments continued during the year on these aspects. Tests on shrimp species for pesticide toxicity were initiated in the Philippines. Shrimp are consumed by humans and are a food source for fish in the Lakes. Some fine-tuning was needed following use of the shrimp test protocols. In Australia, the toxicity tests have been conducted on frog, waterflea and midges, to represent different trophic levels in the aquatic ecosystem. Sorption and degradation studies on pesticides in Australian and Philippines soils are continuing.

LWR/2001/003: Integrated watershed management for sustainable soil and water resources management of the Inabanga watershed, Bohol Island, Philippines

Overseas Collaborating Countries	Philippines
Commissioned Organisation	University of Western Sydney, School of Science, Food and Horticulture College of Science, Technology and Environment, Australia
Project Leader	Professor H. John Bavor Phone: 02 4570 1264 Email: j.bavor@uws.edu.au
Collaborating Institutions	Bureau of Soil and Water Management, Philippines Department of Environment and Natural Resources, Philippines
Project Budget	\$605,311
Project Duration	01/07/2002 to 30/06/2005
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

On Bohol Island there is a move to protect water resources affected by soil erosion and runoff from agricultural lands. In this project scientists are evaluating the extent of soil erosion from agricultural croplands, to measure the sedimentation and water quality of surface waters in the Inabanga River watershed. Researchers are also examining socio-economic and policy issues, to identify constraints that impact on the agricultural sustainability and surface water quality of the Inabanga watershed. The project aims to evaluate different options and impacts for water resource uses in this watershed, using research methodologies that involve farmers, community groups, local and national government and non-government organisations to assist adoption of research outcomes.

Project progress

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

The project has been well established, and considerable progress has been made to gather baseline data and commence the experimental program. Progress against the specific objectives is summarised below.

Objective 1: describe the current land and water resources of the Inabanga watershed using Geographic Information Systems (GIS) and ongoing natural resources management programs in the watershed

Current land use and water systems have been delineated using a range of resources, including, existing data held by Bureau of Soils and Water Management, DENR and regional agencies. Landsat 7 imagery, ground truthing and existing maps in both hard copy and digitised formats have been sourced and/or undertaken.

Objective 2: evaluate the extent of soil erosion from agricultural crop lands, sedimentation and water quality of surface waters in the Inabanga watershed

Experimental plots have been established within the watershed and sampling of water and sediments has commenced. The sites have been selected to allow evaluation of intensively cultivated crops (both irrigated and rainfed), agro-forestry, forestry, grassland and oil palm land usage. Considerable stakeholder input was incorporated into the selection of experimental sites and types of agricultural activity to be evaluated. Evaluation of sedimentation processes and water quality have commenced at a series of water quality monitoring sites transecting the watershed and the major storage dam, the Malinao Dam.

Objective 3: understand the socioeconomic and policy issues, and constraints that impact on the agricultural sustainability and surface water quality of the Inabanga watershed

The research team has collected existing socio-economic information and is commencing integration of the data for incorporation as a GIS information layer. A survey form in Cebuano dialect and local protocols have been developed and piloted in stake-holder meetings and interviews within the watershed. Survey and data collection will continue.

Objective 4: evaluate different options and impacts for water resource uses in the Inabanga watershed

Options and impacts of water resource uses have been incorporated and reviewed in several workshops held with watershed stakeholders (November 2002 and May and July 2003) focussing on sustainable agricultural activity and water quality/quantity protection. Collection of data on water capture and distribution from the major storage facilities on the Inabanga River has commenced. Options evaluation will continue as an ongoing component of the project.

Objective 5: enhance/strengthen the research capacity/capability of staff in the Bureau of Soil and Water Management, Department of Environment and Natural Resources and local project collaborators

The project has enabled and enhanced a research and extension service capacity for the Bureau. Two recent Philippine graduates have been located within the regional Agricultural Promotion Centre (APC) on Bohol. They are key to the on-site project activity but also represent a *back-to-the-community* placement, as both of the graduates are of Boholano origin. This placement is perceived by the community as a positive recognition of the importance of their watershed, as two of their own overseas trained people have been specially designated to work with the community.

As local JICA activities are being completed in a number of APC collaborations, APC staff are developing Inabanga watershed projects to link with our ACIAR Project, recognising the potential for extended use of data that the Project is gathering – for use in APC activities (eg. fertiliser comparisons, crop productivity variation within the watershed, etc).

The Provincial Planning and Development Office, Bohol, has already incorporated project-generated GIS image materials into their own planning documentation and planning capacity.

Objective 6: transfer research outputs to stakeholders of soil and water management

Stakeholders have taken an active part in the selection of experimental sites and types of agricultural activity being evaluated. A sense of regional ownership of the project is being engendered through such active participation. Regional and municipal agriculture officers, provincial planners and DENR have all been included in the project establishment and will continue to take an active part in the ongoing research activities and dissemination of research outcomes.

PHT/1994/045: Control of ripening in papaya and mango by genetic engineering

Overseas Collaborating Countries	Malaysia, Philippines
Commissioned Organisation	University of Queensland, Department of Botany, Australia
Project Leader	Dr Jose (Jimmy) Botella Phone: 07 3365 1128 Email: Botella@botany.uq.edu.au
Collaborating Institutions	University of the Philippines at Los Banos, Philippines Malaysian Agricultural Research and Development Institute, Malaysia Queensland University of Technology, Australia
Project Budget	\$951,654
Project Duration	01/07/1997 to 31/12/2005 (Project extended from 01/07/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

The project aims to improve the postharvest characteristics of papaya fruits. Poor storage life limits and affects domestic and export marketing throughout Southeast Asia. The project is providing the foundations for plant tissue culture and transformation in mango, one of the more important fruit commodities in the region. The primary focus has been the use of genetic engineering techniques to extend fruit storage-life. The project researchers are working to identify, isolate and clone two important genes in the ripening process: 1-aminocyclopropane 1-carboxylate (ACC) synthase and polygalacturonase (PG). This will allow preparation of antisense constructs, and the introduction of the altered genes back into the plant using a previously developed transformation system. As a consequence of this project transgenic papaya plants will be produced with low expression of either gene ready for glasshouse evaluation. Tissue culture and embryogenesis systems that will facilitate genetic manipulation of mango are also being produced. The project brings together complementary expertise from five different groups. Major outcomes are expected to be the production of Philippines, Malaysian and Australian cultivars of papaya with better postharvest characteristics, the optimisation of a regeneration system for mango, the transfer of generic technology and the development of a strong collaboration that will extend to the study of other tropical fruits.

Project progress

Year 6 (10/2002-10/2003)

Project work to date has sought to produce trees which exhibit a delayed response to the fruit ripening process. Papaya is the model chosen for this procedure, since it is both a commercially valuable crop and has a relatively rapid life cycle for a fruiting tree.

Australia

Carica papaya cultivar 'Sunrise Solo' field trials: Field trials have been in operation for 12 months, with plantings continuing throughout the year. At this point in time, 87 papaya plants have been put into the field, including six sense/antisense transformants. The Office of the Gene Technology Regulator (OGTR) has given approval for the field trial has been given, with a Licence to carry out the work commencing June 21st 2003. The first OGTR inspection of the site was carried out in September 2003. The first transgenic trees are now commencing fruit ripening. The initial ten fruit are left on the tree, and the times taken from green ripe to full yellow stage are recorded. All measurements are carried out using wild type and non-transformed trees as control plants.

Carica papaya cultivar 'Sunrise Solo' tissue culture I: embryos were dissected out from seeds of immature fruit from cultivar 'Sunrise Solo'. These embryos were transformed (via particle bombardment) using a range of constructs: *capacs1* sense/antisense, *capacs2* sense/antisense, *Etr1-*

1 and *GUS*. All embryos were co-transformed with vector pGTVb, carrying the kanamycin resistant *nptII* gene.

Carica papaya cultivar 'Sunrise Solo' tissue culture II: plants derived from the transformation events are now undergoing organogenesis prior to being acclimatised from tissue culture to soil. Over 100 sense/antisense lines have been made, with most now undergoing root induction. A further 5 lines contain the construct *Etr1-1*. At this stage, the plants are tested for transgenic status prior to transfer to soil. Tests are performed using PCR analysis for plant sex and transgenic status. Several non-transformed plants from each group are retained to act as controls for the experiment.

Philippines

Molecular subprogram for papaya: since papaya ringspot virus disease is a major problem in the papaya fruit industry especially in Luzon, it has been an objective to attempt to incorporate the two traits of delayed ripening and PRSV resistance. Both genes involved will be inserted into a single pISA vector.

Papaya transformation subprogram: induction and maintenance of primary somatic embryos is continuously being undertaken. Sixty-three lines of transgenic papaya seedlings are now in tissue culture. The optimisation of rooting conditions and the acclimatisation of potted out seedlings is continuing. Embryo rescue of immature seeds is being performed on some transgenic fruits; micropropagation methods of transgenic plants are sought to generate further clones. Transformation of somatic embryos is continuing. A modified selection procedure is being used to regenerate putative transgenic plantlets.

Screenhouse evaluation of transgenic papaya plants: First generation plants (T_1) of transgenic line 213 have been established in the screenhouse. Seventeen of these are now commencing flowering. Ten other transgenic (T_0) lines have also been transferred to the screenhouse. Four transgenic fruit were harvested and their characteristics compared to wild type plants. Fruit qualities were all identical to non-transgenic fruit, except for size, which was notably smaller. Trees have been planted in a bigger space to increase vigour and productivity.

Mango tissue culture subprogram: Mango is considerably more difficult to grow in tissue culture than papaya. The research has now focused on the complete plantlet regeneration from germinated somatic embryos of mango variety 'Carabao'. Eight cultivar strains of 'Carabao' mango are being investigated, with the first plantlets being acclimatised prior to transfer to soil.

Malaysia

Cloning of an ACC synthase cDNA from "Eksotika" papaya fruit, and sense construct of pGTVa-PACCS2s: One partial cDNA of ACC synthase, PACCS2, was isolated by RT-PCR from total RNA of ripening 'Eksotika' papaya fruit. PACCS2 has 98.2 per cent deduced amino acid similarity to CAPACS2, the 'Sunrise Solo' homologue. One sense gene cassette of pGTVa-PACCS2s was constructed using the pGTVa vector.

Papaya transformation: 50 lines of papaya variety 'Eksotika' have been transformed with CAP2A (pGTVa-CAPACS2a). A further 19 lines have been transformed with the pISA CAPACS2 sense-antisense construct. Further transformations are in progress using the 'Eksotika' PACCS2 gene.

PHT/2000/081: Bioremediation technology for insecticide residues in horticulture

Overseas Collaborating Countries	Philippines
Commissioned Organisation	CSIRO Entomology, Australia
Project Leader	Dr John Oakeshott Phone: 02 6246 4157 Email: John.Oakeshott@ento.csiro.au
Collaborating Institutions	ORICA Australia Pty Ltd, Australia University of the Philippines at Los Banos, Philippines University of the Philippines, Diliman, Philippines
Project Budget	\$398,625
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Pesticide contamination of commodities and waste water presents major problems for agricultural production and processing industries in the Philippines and Australia. Pesticide residues cause two types of problems in agriculture, one involving residues in the environment and drainage waters and the other involving residues on horticultural and other commodities. This project is addressing the problem of pesticide contamination of horticultural products. Project scientists are employing an Australian technology that uses enzymes produced by bacterial fermentation to degrade toxic residues, rendering them harmless. They are adapting procedures used in other situations to apply these to postharvest clean-up of insecticide residues on the surfaces of horticultural commodities. This use of the technology is expected to make fruits and vegetables safer to eat and enhance the market competitiveness of the commodities.

Project progress

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

The presence of pesticide residues on horticultural produce is of concern because of its direct toxicity to consumers, its environmental pollution and also because of increasingly stringent requirements in many countries concerning the concentration of residues on imported produce.

CSIRO Entomology, in conjunction with ORICA Australia Pty Ltd and Horticulture Australia Limited, has developed an enzyme bioremediation technology for the removal of certain organophosphate, carbamate and pyrethroid insecticides from irrigation drainage water and the surfaces of horticultural commodities. This project aims to develop protocols for applying the current suite of enzymes, after harvest, on four main crops (tomatoes, bananas, mangoes and eggplants).

Preliminary data from the trials conducted at the University of the Philippines indicate that at least 60 per cent of diazinon residues and >70 per cent fenitrothion residues can be removed from the surfaces of eggplants with 30 minute treatments of our organophosphate degrading enzyme. Furthermore, >65 per cent of fenitrothion residues could be removed from tomatoes with a 60 minute treatment with enzyme. This latter result is particularly encouraging in view of the fact that tomatoes generally retain more pesticide residues than eggplants.

SMCN/2000/114: Evaluating biofumigation for soil-borne disease management in tropical vegetable production

Overseas Collaborating Countries:	Philippines
Commissioned Organisation	CSIRO Plant Industry, Australia
Project Leader	Dr John Kirkegaard Phone: 02 6246 5080 Email: John.Kirkegaard@csiro.au
Collaborating Institutions	Benguet State University, Philippines University of the Philippines at Los Banos, Philippines Queensland Department of Primary Industries and Fisheries, Australia
Project Budget	\$398,625
Project Duration	01/01/2001 to 31/12/2004 (Project extended from 01/01/2004 to 31/12/2004)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Vegetables suffer losses due to a variety of soil pathogens both in Australia and the Philippines. Soil fumigation is expensive, and the preferred fumigant, methyl bromide, is being phased out. Biofumigation, in this instance the incorporation of residues of certain varieties of brassicaceous crops, has been shown to reduce the levels of several soil pathogens, including bacterial wilt and root knot nematode (*Meloidogyne*). Biofumigation is, however, still in its infancy. This project is testing a range of brassicaceous crops for their suitability for planting in the tropics, in central and northern Queensland and in Luzon, with the aim of using any identifiable biofumigant effects against bacterial wilt and *Meloidogyne*. The most effective cultivars are being tested in the field, including farmers' fields, for their ability to reduce losses caused by these soil pathogens in tomato, potato, egg plant and other solanaceous vegetable crops. If successful, biofumigation will be incorporated into an integrated pest management package for dissemination throughout Southeast Asia.

Project progress

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

The major activity during this reporting period was field evaluation of the most promising brassicas for biofumigation of bacterial wilt and root knot nematodes and development of protocols to improve field efficacy. This included some preliminary experiments on commercial farms and small-scale farmer fields. Some laboratory experiments to finalise investigations to identify the active components of incorporated green manures were conducted.

Bacterial Wilt: The 2003 field experiment conducted at Southedge Research farm near Mareeba, Australia provided the most promising results to indicate the effectiveness of selected brassica biofumigants against bacterial wilt. The incorporated brassica green manures delayed the onset, significantly reduced the incidence and severity of wilt and increased tomato yield compared with the weedy fallow or soybean controls. The mustard (*Brassica juncea*) treatments were the most effective and the rape treatments (*B. napus*) the least, consistent with previous laboratory experiments on suppression by volatiles released from leaf tissues of these species. The best mustard treatments (Nemfix) reduced wilt severity from 4.8 to 2 (0-5 scale) and increased tomato yield from 2.5 t/ha to 20 t/ha. These results suggest that where Brassica material is grown in sufficient quantity (5 kg/m² fresh material), and managed to achieve high levels of ITC release (i.e. tissue maceration, adequate and rapid incorporation and irrigation), that significant suppression of bacterial wilt can be achieved in the field, consistent with that demonstrated in laboratory and glasshouse studies.

In the Philippines, where it was more difficult to achieve all of these conditions in the field experiments, there were no consistent effects of Brassica amendments on the incidence of wilting in following vegetable crops in the five field experiments conducted in 2003-04. Generally, non-brassica

and brassica treatments had similar impacts on wilt incidence, and no treatment performed consistently well across sites. Of the brassicas tested, radish and broccoli showed the most promise, each providing significantly lower wilt incidence than the non-brassica control at one site (each reduced wilt by 50 per cent). Covering the plots with black plastic following incorporation did not influence bacterial wilt levels. The reduced and variable impacts of brassicas in these experiments may have arisen from insufficient mixing of the material through the soil, as the macerated Brassica material was restricted to a band and covered, which would leave significant amounts of soil 'untreated' in the vicinity of subsequent crop roots.

Work to date has demonstrated that brassica green manures can significantly reduce bacterial wilt of following vegetable crops when managed to maximise the biofumigation impacts of ITCs, and we have developed a 'best-bet' approach to achieve this outcome. Other mechanisms of suppression also arise from incorporation of green material irrespective of its origin, and this may explain the lower and more variable results observed where incorporation techniques do not maximise ITC release.

Root-knot nematodes: Generally incorporation of all green manures including non-brassica controls reduced nematode numbers (by 47–85 per cent) compared with increases in nematodes in untreated controls (12.6 – 55.7 per cent). In most cases the suppression was similar for brassica or non-brassica treatments although the effectiveness of radish, which has been observed in previous years, was again apparent at some sites. The laboratory experiments confirmed that all components of macerated green manures (volatile, water soluble and organic matter) could cause significant independent suppression of nematode numbers. Overall the results indicate that selection of green manures which are poor hosts of nematodes (e.g. among the brassicas, radish and broccoli) combined with tissues suppressive upon incorporation (radish and mustard) is desirable, but that significant suppression in the field was observed for several non-brassica species.

The project has developed 'best-bet' strategies for the use of biofumigant green manures as a component of control strategies for these pest organisms, however further evaluation in commercial paddocks and farmer fields is required to establish robust and consistent approaches compatible with various production systems.

Multilateral

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

Overseas Collaborating Countries	Malaysia, Philippines, Thailand, Vietnam
Commissioned Organisation	International Plant Genetic Resources Institute, Malaysia
Project Leader	Dr V. Ramanatha Rao Phone: +60 3 8942 3891 (Malaysia) Email: v.rao@cgiar.org
Collaborating Institutions	Griffith University, Australia Department of Agriculture, Thailand Institute of Agricultural Genetics, Vietnam University of the Philippines at Los Banos, Philippines Universiti Kebangsaan Malaysia, Malaysia
Project Budget	\$746,479
Project Duration	01/01/2003 to 31/12/2005
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

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

Project progress

Year 1 (01/01/2003–31/12/2003)

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

Cryopreservation techniques such as encapsulation dehydration, vitrification, new encapsulation-dehydration and slow freezing were attempted to conserve different plant materials. Developing-country partners were trained in using these techniques through a course organised at Griffith University, Australia in September, 2003. At the end of the course, each trainee developed a re-entry plan in line with project activities, to be implemented upon return to their institutions. Initial work on cryopreservation of papaya, citrus, Australian native fruits (citrus and Davidson plum) showed promising results. Work on mango, persimmon, litchi and longan has progressed well in establishing micropropagation systems.

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

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

Overseas Collaborating Countries	Philippines, Thailand, Vietnam
Commissioned Organisation	International Rice Research Institute, Philippines
Project Leader	Dr Thelma Paris Phone: +63 2 845 0563 Email: t.paris@cgiar.org
Collaborating Institutions	Curtin University of Technology, Australia Khon Kaen University, Thailand Cuu Long Rice Research Institute, Vietnam
Project Budget	\$496,764
Project Duration	01/01/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Colin Piggin

Project background and objectives

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

Project progress

The first progress report is due in early 2005.

CIM/2002/106: Fertilisation-independent formation of embryo, endosperm and pericarp for apomictic hybrid rice

Overseas Collaborating Countries	Philippines
Commissioned Organisation	International Rice Research Institute, Philippines
Project Leader	Dr John Bennett Phone: +63 2 845 0563 Email: J.Bennett@cgiar.org
Collaborating Institutions	CSIRO Plant Industry, Australia
Project Budget	\$1,500,000
Project Duration	01/07/2003 to 30/06/2008
ACIAR Research Program Manager	Dr Colin Piggitt

Project background and objectives

The productivity of irrigated rice in farmers' fields has stagnated over the last 15 years. As a result, the rate of increase in rice production has fallen below the rate of population increase, creating concern for future food security, particularly in Asia. Hybrid rice has shown yields up to 30 per cent higher than open-pollinated varieties, and some 17 million hectares is grown, predominantly in China. However, the high cost and inflexibility of hybrid seed production are two of the major impediments to the wider spread of hybrid rice outside China. Some of these difficulties could be overcome through apomixis, the naturally occurring ability of some plant species to reproduce asexually through seeds that leads to inheritance of genes exclusively from the mother—meaning that plants growing from these seeds are identical to the mother plant. This project aims to make the benefits of high-yielding hybrid rice available to poor farmers in Asia through apomictic hybrid seed production.

Project progress

First progress report is due in September 2004.

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

Overseas Collaborating Countries	Colombia, Indonesia, Kenya, Philippines, Vietnam, Zimbabwe
Commissioned Organisation	International Centre for Tropical Agriculture, Laos
Project Leader	Dr Rod Lefroy Phone: +856 20 509863 Email: r.lefroy@cgiar.org
Collaborating Institutions	International Centre for Tropical Agriculture, Colombia Bureau of Soil and Water Management, Philippines 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 Center for Soil and Agroclimate Research, Indonesia
Project Budget	\$434,130
Project Duration	01/07/1999 to 30/06/2005 (Project extended from 01/07/2002 to 30/06/2005)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

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

Project progress

Outcomes to June 2003

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

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

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

other factors associated with low-quality manure that need to be measured in order to improve the capability of the module.

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

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

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

Concluded projects

1 July 2002–30 June 2004

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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 Email: R.Copland@uq.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 fasciolosis 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.

AS2/2000/098: Bovine babesiosis and anaplasmosis in the Philippines: developing a research and diagnostic capability

Overseas Collaborating Countries	Philippines
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Animal Research Institute, Australia
Project Leader	Dr John Molloy QDPIF Animal Research Institute Phone: 07 3362 9413 Email: molloyj@dpi.qld.gov.au
Collaborating Institutions	Bureau of Animal Industry, Philippines
Project Budget	\$149,798
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

There is an urgent need in the Philippines for reliable, international standard diagnostic capabilities for tick-borne diseases. The existence of these diseases within the Philippines has only become apparent in recent times. But their extent is unknown and now trade disputes have arisen over the inferred importation of these diseases in live cattle. The project aimed to utilise technologies developed elsewhere in ACIAR-supported projects and transfer these to the regulatory and diagnostic authority, the Philippines Animal Health Bureau. Staff from the AHB received training in Australia and the Philippines in the application of these diagnostic tools. The system was tested, and further epidemiological training provided, through the conduct of a survey carried out in a selected region of the Philippines allowing the incidence and impact of tick-borne diseases in smallholder cattle to be determined.

Project outcomes

The project resulted in the development of centres of expertise in the diagnosis and control of tick fever in the key laboratories in Manila and Davao that service the major cattle producing and cattle importing areas in the north and south of the Philippines. These laboratories are now recognised reference centres for the rest of the country and models for establishing similar expertise in Regional Animal Disease Diagnostic Laboratories (RADDL) throughout the Philippines. Staff from 13 RADDL has already been trained to accurately diagnosis babesiosis and anaplasmosis by microscopic examination of blood smears from sick cattle.

The completion of serological surveys established the distribution of babesiosis and anaplasmosis in the Philippines, with both diseases present virtually throughout the country. DNA based strain-typing tests, developed in the project are now capable of differentiating between Australian and Philippine strains of *A. marginale* and *B. bigemina*. These tests will prove invaluable for determining the origin of outbreaks of tick fever that occur periodically in cattle imported from Australia.

Improved diagnostic tests for tick fever are now in routine use in both the Philippines and Australia. As a result of the project the Philippines has been left with a stockpile of diagnostic reagents sufficient to meet foreseeable needs and to conduct further serological surveys as required.

The project facilitated collaboration between the Australian project team and recognized world experts in the USA, that resulted in the capacity to culture *A. marginale* in tick cells being established in DPI&F laboratories in Brisbane. The ability to culture *Anaplasma* is critical to ongoing DPI&F research to produce safer and more efficacious vaccines to protect cattle against tick fever.

The project has made a significant contribution toward creating the disease diagnosis and surveillance capability that will underpin the success Philippines government initiatives to build profitable livestock industries. The Philippines government is committed to improving animal health and nutrition and to a programme of importation of breeder cattle to improve the productivity of local beef breeds and to build a viable local dairy industry. A rapid and accurate service for the diagnosis

and treatment of tick fever outbreaks in both local and imported cattle is now available. The epidemiological surveys conducted within the project have provided livestock owners and government policy makers with up to date data on the distribution and economic impact of TBD that will allow them to make informed decisions about the future of breeder importation programmes, breed selection and the implementation of tick and TBD control strategies.

The project has benefited both the Philippines and Australia by contributing to the development of a more stable trading relationship based on up to date and clear knowledge. As an example, a recent outbreak of tick fever in cattle imported to the island of Masbate from northern Australia was quickly resolved without any disruption to trade, through rapid and accurate diagnosis of the problem and the ability to demonstrate that the outbreak was due to tick-borne exposure to a local parasite strain after arrival in the Philippines. Demonstration that babesiosis and anaplasmosis already occur throughout the Philippines has largely overcome concerns about the risks associated with the introduction of Australian parasite strains in imported cattle.

The project has also provided a boost to the Philippines government initiative to establish a viable local dairy industry. Cooperation between the project team in Manila and the Philippines National Dairy Authority has identified tick fever as the major cause of disease outbreaks that occur regularly in imported cattle and result in substantial loss of valuable breeding stock. Strategies have now been put in place to minimise tick-borne exposure and vaccinate imported animals on arrival.

The most important impact of the project on rural communities in the Philippines is indirect, and depends largely on the overall success of the government's initiative to improve animal health and nutrition. Should they succeed the long term impact will undoubtedly be positive with an increase in rural wealth as a consequence of the increased profitability of livestock industries. A more immediate impact may be the creation of employment opportunities in rural areas as a result of the growth of feedlots and related industries that rely to a large extent on the smooth operation of the live cattle trade with Australia.

Positive benefits to Australia include the availability of improved diagnostic tests and stimulation of ongoing DPI&F research programmes to improve the control of tick fever. In particular, the ability to grow *A. marginale* in tick cell culture has been a catalyst for the development of several new projects aimed at improving the current tick fever vaccines. The development of an advanced disease diagnosis and surveillance capability in strategic laboratories in Southeast Asia is another positive benefit for Australia in that it contributes to regional biosecurity and acts as an early warning system for Australia's exotic disease surveillance programmes.

ASEM/1998/052: Enhancing farmer adoption of simple conservation practices: landcare in the Philippines and Australia

Overseas Collaborating Countries	Philippines
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Noel Vock Phone: 07 5444 9614 Email: noel.vock@dpi.qld.gov.au
Collaborating Institutions	SEAMEO Regional Centre for Graduate Study and Research in Agriculture, Philippines World Agroforestry Centre, Philippines Barung Landcare Association, Australia Department of Natural Resources and Mines, Queensland, Australia University of Queensland, Australia Queensland Fruit and Vegetable Growers, Australia
Project Budget	\$879,904
Project Duration	01/07/1999 to 30/06/2004 (Project extended from 01/07/2003 to 30/06/2004)
ACIAR Research Program Manager	Dr Ken Menz

Project background and objectives

Worldwide there are few examples of successful adoption of the conservation practices emerging from research. This is especially so in the upland regions of the developing world. This project involved community and industry-led groups in upland municipalities of Mindanao, Philippines, working with scientists to test how well the managed participatory approaches of the Australian Landcare Movement could assist the adoption of simple conservation practices. Many practices have arisen from research funded by ACIAR and ICRAF (International Centre for Research in Agroforestry), and with the support of local government units adoption of the Landcare approach has been accelerated. Australia's Landcare Movement strongly supported the project, which was also aligned with an Australian Federal Government initiative considering the international application of Landcare.

Project outcomes

The project has demonstrated, via the Landcare approach, that farmer-led participatory development processes can achieve a greater degree of change than the traditional 'dole-out' and top-down approach of implementing projects, often evident in the Philippines. More than 400 Landcare groups are now in operation at the three project sites in the island of Mindanao (a region whose high poverty levels have gained it special attention for Australian development assistance). Over 4230 households are now involved as members of Landcare groups.

The entry point for the formation of the Landcare groups was the conservation technology of leaving unploughed natural vegetative strips (NVS) across the contour. From one-third to two-thirds of farmers in each site adopted soil conservation technologies. At one site there are now 1500 hectares of such strips, at another where there had been minimal adoption prior to project commencement the area is approaching 1000 hectares. Because farm size is small, the change is very significant on a per farm basis.

Following the establishment of grass strips to stabilise soil, there is an evolution towards intensification between and on the strips, particularly via tree planting (in approximately 50 per cent of cases to date). Over 150,000 fruit and timber trees were planted at the Lantapan site during the course of the project, grown from seedlings produced by Landcare groups. Initially the Australian component struggled to apply a Landcare model to the challenging environment of horticultural farmer groups in southeast Queensland. One of its achievements was to work with the Subtropical Treefruit Growers Association to set up an environmental auditing process by its members. In conjunction with

the same group, the project has helped gain funding for a Waterwatch project to monitor water quality. The project has also helped initiate pineapple grower discussion groups with fruit canner Golden Circle, involving around 50 farmers. Project members decided to work with existing industry groups rather than attempt to form new Landcare/Farmcare groups; the more conservative industry groups viewed Landcare as being 'green' rather than being concerned about the broader needs of full time farmers. A change in the name of the program to 'Farmcare' to an extent dissipated some of these concerns.

Both the Philippines and Australian components have dynamically redefined the Landcare approach to incorporate livelihoods perspectives, largely to meet the expressed needs of the farmers with whom the project worked.

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	International Rice Research Institute, Philippines Philippine Rice Research Institute, Philippines Research Institute for Rice, Indonesia
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	To be advised; interim point of contact Dr John Skerritt

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 & 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 per cent at the beginning of the project to 30 per cent for greasy grouper / estuary cod (*E. coioides*), and from 5 per cent at the beginning of the project up to 50 per cent 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 per cent.

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 per cent). 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 per cent) in protein and moderate (12–15 per cent) 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.

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

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

Project background and objectives

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

Project outcomes

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

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

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

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

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

Shade: Growth of *T. ciliata* was examined under an overstorey and in a forest gap. These trees showed performance that exceeded any open-planted *T. ciliata*. Laboratory experiments support this

result, indicating *Hypsipyla robusta* prefers to lay eggs on leaves grown at high light. These experiments suggest the most promising approach to *T. ciliata* silviculture is management of a light environment that optimises the balance between tree growth and insect damage.

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

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

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

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: 07 3896 9345 Email: Andre.Drenth@dpi.qld.gov.au
Collaborating Institutions	Southern Fruit Research Institute, Vietnam Bureau of Plant Industry, Philippines Kasetsart University, Thailand Prince of Songkla University, Thailand Research Institute for Spice and Medicinal Crops, Indonesia Malaysian Agricultural Research and Development Institute, Malaysia
Project Budget	\$149,943
Project Duration	01/07/2000 to 30/06/2003 (Project extended from 01/07/2002 to 30/06/2003)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

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

Project outcomes

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

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

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

An important output of this project is input in other ACIAR projects (PHT/1995/134 Management of *Phytophthora* diseases of durian; PHT/2000/102 Selection for improved quality and resistance to *Phytophthora* pod rot, cocoa pod borer and vascular streak dieback in Indonesia; and CS2/1994/965

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

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

SMCN/2000/060: Development of an interactive diagnostic key for sweet potato disorders

Overseas Collaborating Countries	Philippines
Commissioned Organisation	University of Queensland, Australia
Project Leader	Dr Geoff Norton Phone: 07 3365 1854 Email: G.Norton@cbit.uq.edu.au
Collaborating Institutions	International Potato Centre, Peru PhilRootcrops, Philippines
Project Budget	\$149,880
Project Duration	01/01/2001 to 31/05/2004 (Project extended from 01/07/2003 to 31/05/2004)
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

This small project utilised the results of an earlier project on diagnosis of sweet potato nutrient disorders (LWR2/1991/001) and combined these with existing knowledge of disease and pests of sweet potato to build an electronic diagnostic key for all visual disorders in the crop. Sweet potato experts from several sweet potato growing countries came together to test the prototype product. Extension workers in the Philippines were trained in use of the product, at the same time providing feedback on its fine-tuning, based on experiences in the field with the tool.

Project outcomes

The main outputs from this project consist of a CD product and related field guide for diagnosing problems encountered in sweet potato crops in Southeast Asia, particularly in the Philippines. The CD product incorporates an interactive diagnostic key that has been developed using the Lucid Professional matrix key system. This allows 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 70 possible causes.

There are numerous images and photographs included in the CD to help users diagnose their problem and access relevant information about the problem. The features and symptoms that might be observed are defined and illustrated by notes and images and each problem has a summary fact sheet and a full fact sheet that contains images, textual descriptions of symptoms and signs and other information about particular insect pests, mites, diseases, nematodes and nutrient disorders.

An important feature of this CD product is that users can navigate through the content in any way they want. They can access this information from lists - of insect pests, diseases, nutrient disorders, etc, by using the interactive key and by using a customised search facility.

A Field Guide was developed to complement the CD product. The main sweet potato problems are included in the Field Guide, with brief details about the problem and its management and selected images to illustrate the related symptoms and/or organism. Distribution of the Field Guide has been undertaken throughout the region for use by extension officers, researchers, students and farmers.

During the course of the project, a number of workshops, training courses and field trials were organised to get feedback on earlier versions of the CD product and to assess its value as a training and decision support tool. Extension officers were impressed with the ease with which relevant information about specific problems could be retrieved. Most extension personnel have good access to computers to run the CD, but for some this is not the case and is being addressed to fully utilise the potential of the CD as a training/decision support tool.

The International Potato Center has taken over custodianship of the master version of the Sweet Potato Diagnostic tool.

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.

Projects under development

at 30 June 2004

Bilateral

ASEM/2002/051 Sustaining and growing landcare systems in the Philippines and Australia

ASEM/2003/009 Bridging the gap between seasonal climate forecasts and decision makers in agriculture

ASEM/2003/011: Herbicide use strategies and weed management options in Filipino and Australian cropping

ASEM/2003/052 Market led mechanisms to enhance farmers livelihoods through forestry

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

FIS/2003/033 Management of Philippine lakes for sustainable fisheries and aquaculture: focus on Lakes Taal (Batangas) and Buhi (Camarines Sur)

FST/2004/007 Domestication of Australian trees for reforestation and agroforestry systems in developing countries (2)

LWR/2003/006 Enhancing agricultural production in the Philippines by sustainable use of shallow groundwater

PHT/2003/071 Integrated pest management and supply chain improvement for mangoes in the Philippines and Australia

Multilateral

AS2/2003/063 Assisting the transition of smallholder pig and goat farmers to income generation

Philippines consultations

18–20 March 2002

Priorities for collaborative agricultural research between Australia and the Philippines were discussed on 18–20 March 2002 at a consultation between ACIAR and representatives of relevant national and local Government Departments, private sector associations, national and regional research consortia and research organisations in the Philippines.

These priorities are not to be considered as officially sanctioned priorities of the Government of the Philippines. 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 the Philippines.

Researchers intending to propose collaborative research projects with Philippines counterparts for ACIAR support should, in the first instance, approach one of ACIAR's Research Program Managers.

At the consultation, several overarching issues were identified. These included the need for research to underpin both the development and implementation of *policies that increase the efficiency of agricultural production and marketing*. There is a need to increase the *international competitiveness* of Philippines agriculture, and expand the markets for Philippine agricultural products and services, taking into account the impacts of trade liberalisation. Underlying competitiveness is the need for *improved agricultural productivity to raise rural incomes* - responding to market opportunities with higher quality commodities produced at a competitive cost. Specific opportunities may come through research for development and marketing of higher-value aquaculture, fruit, livestock products and processed foods. Improved productivity should not come at the expense of natural resources degradation, especially of uplands and fragile watersheds and coastal zones.

Research projects should be driven by design processes that include end-users and *address their needs*, be they farmers, processors of agricultural products or policymakers - active involvement of community groups in the districts where the research will be applied and of policy stakeholders in the projects will be encouraged. Project design should also accommodate challenges that have arisen from the *devolution of the management and governance of extension responsibilities* to local government units, and the comparatively poor research-extension linkages that may currently exist. Opportunities exist for *follow-up activities* that enhance the impact of earlier ACIAR projects.

Agreed priorities are listed under ACIAR thematic focus areas:

Meeting the escalating demand for animal protein (livestock and fisheries)

- Improvement of the productivity of smallholder livestock and aquaculture farming systems, including establishing appropriate complementarity with commercial systems
- Technologies and policies to meet livestock and fishery product quality and food safety requirements of markets
- Development of improved surveillance and management capacity for economically-important (including exotic) livestock and fisheries diseases
- Development of sustainable coastal aquaculture systems, including the integration of capture fishery/ culture systems
- Consolidation of available livestock and fisheries research knowledge for use by smallholders, extensionists and educators.

Improving the productivity and efficiency of food crop and forestry systems - Crop production, protection and postharvest technology

- Application of biotechnologies for the improvement of horticultural crops and coconuts (including transformation, bioinformatics and *in vitro* conservation)
- Development and application of diagnostic tools for major crop diseases
- Policy and regulatory standards for the management of pesticide residues and mycotoxins
- Optimisation of postharvest systems and equipment to improve utilisation of crops and byproducts

- Development of information modules and training systems to facilitate the uptake of crop production, protection and postharvest technologies.

Forestry and agroforestry

- Improved cropping and agroforestry options and land management systems for marginal and hilly lands
- Technologies for the mass propagation of genetically-improved forestry species.
- Community-based forestry enterprise development for wood and non-wood products.
- Technologies for quality improvement of timber products, including raw-material product matching and technologies for timber drying and processing.

Better environments from better agriculture

- Research to underpin groundwater management policies (including on saline water intrusion in coastal areas, fertiliser nitrate contamination and aquifer characterisation)
- Improved adoption of soil fertility management and soil and water conservation strategies at the watershed level
- Analysis of the impact of fast-growing trees on the availability and quality of water for agriculture
- Technical and economic analysis of the irrigation requirements of high-value fruit and forest tree plantings.

Linking Farmers to Markets (agricultural economics and policy)

- Analysis and development of market structures to increase smallholder profitability (including the roles of structural inefficiencies, farmer organisations, smallholder-trader relationships and credit and market choices and power in price formation)
- International competitiveness and industry policy research for particular Philippine agricultural commodities (including an analysis of appropriate product processing standards and opportunities for value addition, niche production and marketing)
- Domestic and international commodity production forecasting, application of economic modelling of supply and demand
- Public education and policies for application of biotechnology in agriculture
- Economic assessment of the market potential of individual GM crop products, addressing cost premiums and required price differentials and the distribution of technology returns
- Comparative assessment of the efficiency and effectiveness of different models and mechanisms for the delivery of agricultural extension services in the Philippines
- Application of information and mapping systems to assist in agricultural planning and technology localisation
- Valuation of environmental services required for sustainability of agricultural production.

ACIAR publications

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

Monographs

- 48 Nutrient Disorders of Sweet Potato
- 51 Biological Control of Insect Pests: Southeast Asian Prospects*
- 54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries*
- 58 Understanding Animal Health in Southeast Asia: Advances in the Collection, Management and Use of Animal Health Information*
- 75 Socio-Economic Evaluation of the Potential for Australian Tree Species in the Philippines*
- 83 How to Unravel and Solve Soil Fertility Problems*
- 94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package*
- 96 Rats Mice and People: Rodent Biology and Management*
- 97 Effects of Globalisation and Economic Development on the Asian Livestock Sector*
- 100 Field Methods for Rodent Studies in Asia and the Indo-Pacific*

Proceedings

- 33 Sustainable Agriculture on Marginal Uplands of Southeast Asia
- 45 Bacterial Wilt
- 50 Postharvest Handling of Tropical Fruit
- 57 Leucaena: Opportunities and Limitations*
- 61 Agricultural Impacts on Groundwater Quality
- 63 Matching Trees and Sites
- 71 Grain Drying in Asia
- 74 Sustainable Parasite Control in Small Ruminants
- 81 Disease Control and Storage Life Extension of Fruit
- 70 Management of Clay Soils for Rainfed Lowland Rice-based Cropping Systems
- 74 Sustainable Parasite Control in Small Ruminants
- 94 Classical Swine Fever and Emerging Diseases in Southeast Asia
- 97 Hypsipyla Shoot Borers in Meliaceae*
- 100 Quality Assurance in Agricultural Produce*
- 105 Postharvest Handling of Fresh Vegetables*
- 106 Water Policy Reform: Lessons from Asia and Australia*
- 108 Development Strategies for Genetic Evaluation for Beef Production in Developing Countries*

Technical reports

- 08 New Technologies for Rainfed Rice-based Farming Systems in the Philippines and Sri Lanka
- 13 Rainfed Rice Production in the Philippines: a combined agronomic/economic study of Antique Province
- 18 Post-Flask Management of Tissue-cultured Bananas
- 30 A Review of the Biology and Management of Rodent Pests in Southeast Asia
- 55 Chromolaena in the Asia-Pacific Region*

Research Notes

- 24 Bringing trees back in the Philippines*
- 26 Non-chemical Control of Rodents in Lowland Irrigated Rice Crops*

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*