



Australian Government

Australian Centre for
International Agricultural Research

COUNTRY PROFILE 2007

PAPUA NEW GUINEA



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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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1 Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of bilateral and multilateral projects with Papua New Guinea that were active from 1 July 2006 to 30 June 2007. At that time there were 35 active bilateral projects, and three active multilateral projects, the latter being led by international agricultural research centres. There were another 15 projects under development, many of which are expected to start in 2007–08 financial year.

This publication also sets out the key outputs and outcomes from 14 bilateral projects and two multilateral projects that have been completed between 1 July 2006 and 30 June 2007.

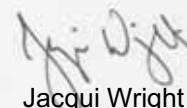
In addition to these project summaries, the publication includes an extract from ACIAR's 2006–07 Annual Report covering Papua New Guinea, our near-term program as outlined in the 2007–08 Annual Operational Plan, and a summary of ACIAR's training program.

ACIAR updates this profile each year and distributes it to key stakeholders in Papua New Guinea and Australia.

We hope you find the publication useful as a record of the progress and achievements between Papua New Guinea and Australia. For information on ACIAR's overall program, we invite you to visit our website at www.aciar.gov.au.



Peter Core
Chief Executive Officer
November 2007



Jacqui Wright
ACIAR Country Manager, Papua New Guinea

2 Overview

2.1 ACIAR

The Australian Centre for International Agricultural Research (ACIAR) is an Australian Government Statutory Authority that operates within the portfolio of Foreign Affairs and Trade. It was established in June 1982 under the ACIAR Act to assist and encourage Australia's agricultural scientists to use their skills for the benefit of developing countries, and at the same time work to resolve Australia's own agricultural problems.

ACIAR's aims to enhance rural household incomes and broader economic growth by investing in international research partnerships that encourage agricultural development, sustainable use of natural resources and capacity-building of benefit to partner countries and Australia.

Research funded by ACIAR is mutually beneficial to Australian and developing country rural industries by harnessing Australia's outstanding strengths in agricultural research to develop partnerships with developing country research institutions.

ACIAR is based in Canberra, with offices in China, India, Indonesia, Papua New Guinea, the Philippines, Thailand and Vietnam.

Australia is in a particularly strong position to provide such assistance because it has a broad range of climates – cool and warm temperate, subtropical and tropical – that are typical of the developing world. Australia's scientists work within a very strong network of institutions, such as the CSIRO, Federal and state government organisations and universities.

The Australian Centre for International Agricultural Research (ACIAR) carries out research in the Asia-Pacific region, and currently has projects in the following regions:

- South-East Asia (Vietnam, Cambodia, Laos, Thailand, Indonesia, Philippines: >45% bilateral expenditure)
- Papua New Guinea and the Pacific islands (>20% of bilateral expenditure).
- North Asia (China: <15% of bilateral expenditure)
- South Asia (India, Pakistan, Bangladesh, Bhutan, Afghanistan, Iraq: <15% of bilateral expenditure)

ACIAR is also responsible for Australia's relationship with the International Agricultural Research Centres—the Consultative Group on International Agricultural Research (CGIAR) centres. ACIAR's annual outlay to the CGIAR centres is around \$11 million.

These funds are used to facilitate CG engagement in the Asia-Pacific and to commission projects that are consistent with ACIAR's country program strategies.

2.2 Country Portfolio

ACIAR has supported a program of collaborative agricultural research with Papua New Guinea since 1983. Most of the program consists of bilateral projects, in which an Australian research organisation is commissioned to undertake a specified research activity in collaboration with a partner organisation in Papua New Guinea. Papua New Guinea is also targeted in ACIAR's multilateral program delivered in conjunction with the international agricultural research centres.

ACIAR's program with Papua New Guinea as at 30 June 2007.

Bilateral Program

Active projects	43 with a value over their lifetime of approximately \$19,571,046
Projects under development	14
Share of South East Asia program	\$4,797,959 which represents 64.1% of the total 2006-2007 PNG & Pacific Island Countries program.
Completed projects	77

Multilateral Program

Active projects	3 with a value over their lifetime of approximately \$928,442
Projects under development	1
Completed projects	6

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3.3 Policy Advisory Council member

The ACIAR Policy Advisory Council is established under the Australian Centre for International Agricultural Research Act 1982. Members are appointed by the Minister for Foreign Affairs, and represent ACIAR's key stakeholders or the implementing agencies for ACIAR's program in partner countries and Australia. Council members are drawn from government departments, research providers and industry, and are therefore well placed to advise on their respective countries' development and agricultural priorities and research needs.

The current member from Papua New Guinea is Mr Brown Bai, Chairman, Rural Industries Council. Mr Bai has been a member of the Council since March 2005.

4 Training

The ACIAR training program has a budget in 2007–08 of approximately \$5.57 million. It comprises five elements:

- Fellowships for postgraduate students (John Allwright Fellowships)
- Postgraduate returnee follow-up awards (Returnee Small Project Awards Scheme)
- Leadership development opportunities for developing country scientists (John Dillon Memorial Fellowships)
- Non-award training (short courses and workshops)
- Support for the Crawford Fund, both through management of the Australian Government's contribution (\$0.70 million) and sponsorship of attendees at Master classes and other selected training activities.

Much of ACIAR's training is carried out systematically within individual projects. In addition, specialised, discipline-specific training activities may also occur within ACIAR's individual research and development programs.

The ACIAR John Allwright Fellowship Scheme accounts for approximately \$4.53 million (this figure includes \$3 million from AusAID) of the training program budget in 2007–08. The objective of the Scheme is to increase the research and development capacity of ACIAR partner country institutions. It provides funding for promising overseas researchers associated with ACIAR projects to undertake postgraduate studies in tertiary institutions in Australia.

John Allwright Fellowship Statistics

		PhD	MSc/Other
Active	Male	8	5
	Female	3	3
Concluded	Male	2	8
	Female	0	3

5 Annual Report 2006-07

Active projects in 2006-07	54
AOP budgeted expenditure in 2006-07	\$4,735,720
Actual expenditure in 2006-07	\$4,797,959
Expenditure in 2005-06	\$4,704,653
Expenditure in 2004-05	\$4,226,822

Key performance indicators	Performance 2006-07
Enhanced focus in project portfolio on improving the quality of commodities	Six new projects have strong emphases on processing quality: four new forestry projects concerned with wood quality improvement; one on sweet potato marketing and postharvest handling and one targeting increasing pyrethrum content of harvested flowers.
Maintain linkages between at least three ACIAR projects and three AusAID-funded Agricultural Innovations Grant Facility (AIGF) projects	ACIAR projects maintained links with AIGF projects on coffee growers/farmers production and marketing groups; management of potato late blight and on enhancing the capacity of village extension workers and farmers to improve income from horticultural crops.
Greater involvement of PNG University of Technology (UNITECH) in ACIAR's program	An ACIAR scholarship scheme has been implemented to allow PNG nationals to undertake postgraduate training in-country while linking to ACIAR projects. UNITECH is also now directly involved in six ongoing ACIAR projects.
Increased emphasis in ACIAR portfolio on sweet potato research and development, commensurate with its importance as a staple food	A comprehensive portfolio of projects has been developed focusing on production and marketing of sweet potatoes, addressing pests, soil constraints, varietal selection, nutrition, marketing and post harvest technology.
Potential role of indigenous nuts in local economies defined	Key issues involved in the domestication and commercialisation of indigenous nuts and fruits of PNG were examined. Nearly all the farmers interviewed indicated a desire to grow more nut trees than they currently do, in particular for the generation of income. A new project is identifying and propagating superior nut cultivars, and developing a marketing strategy.
Extent of soil fertility decline of PNG highlands quantified and suitable research and development investments to improve soil fertility implemented	The extent of soil fertility decline and major constraints to production of the most important staple, sweet potato, were identified. Project initiated to investigate improved nutrient and water management options.
A major thrust to consolidate the development of inland aquaculture, with increased geographic coverage and new attention to promising indigenous species	National meeting held that brought together key stakeholders in the industry to discuss opportunities. Strategic industry planning exercise will be driven by the National Fisheries Authority with technical support from ACIAR. New project on the culture of indigenous fish species underway in Western Province.
Fingerling production and supply to inland fish farmers significantly improved in quantity and quality	A mid-project review was undertaken and remedial action agreed with key agencies to address problems encountered with fingerling production and project delivery at Aiyura Highlands Aquaculture Development Centre and at Erap.
Forty per cent of new projects designed to have significant farmer or policy-maker impacts within five years of completion ("Category 1")	Five out of six small research activities and two out of six new full projects are ranked as Category 1.

5.1 Position

Papua New Guinea is one of ACIAR's most important partners. ACIAR's investment and commitment in PNG reflects the deep, long-term relationship between the two countries. Overall, PNG is one of Australia's largest development partners. Australia is committed to seeing PNG develop and prosper. ACIAR's program in PNG has endeavoured to reflect this and over recent years the portfolio has increased significantly. Since 1998, ACIAR and AusAID have worked and continue to work together to develop and fund a set of projects of mutual interest, through a Record of Understanding which provides funding of \$ 2m annually for support of bilateral projects. In 2003, AusAID established the PNG Agricultural Innovations Grant Facility (AIGF), which supports small projects in PNG agricultural research and extension institutions. Some of these projects relate to previous or current ACIAR-funded projects at these institutions. ACIAR will link closely with the new AusAID-funded PNG Agricultural Research and Development Support Facility, programmed to commence in 2006–07.

PNG faces some formidable challenges to its agricultural development. It is a net food importer with high population growth rates. Village-based agriculture supports 70–80 per cent of the population, and domestic trading of fresh produce is a very important source of cash income. By far the most important crop in PNG is sweet potato. Other root crops are also important but well below sweet potato. The main cash crops in order of export value are oil palm, coffee, cocoa and coconuts. Domestic trading of fresh produce is a very important (and often under-recognised) source of cash income. Domestically marketed food is second to oil palm in value to the economy. Forestry is PNG's third largest revenue earner and a major contributor to the overall economic and social development of the country. The PNG fisheries zone of 2.4 million square kilometres is the

largest in the South Pacific. The fisheries zone includes an extended reef system, numerous islands and an extensive coastline. These create huge opportunity but also present an enormous challenge for monitoring and control. The total market value of the PNG catch is estimated at AUD140–160 million.

ACIAR's program recognises the many challenges to agricultural development in PNG, including poorly developed infrastructure, weak market signals and services, poor product quality, population pressure and future impacts of HIV/AIDS on the farming sector. Major changes to the rural environment over the last decade include greater exposure to global markets, devaluation of the Kina, pressure on land and renewable resources as a result of population increases, and new pest and disease threats. These mean that as well as making a greater commitment to the implementation of the results of research, the need for on-going development of agricultural technologies remains strong.

ACIAR has funded some highly successful projects in PNG. Examples include control of the plant pest banana skipper and identification of the pheromone of cane borer (enabling its numbers to be monitored in the field), research on halting the spread of bee mites in PNG, conservation of indigenous plants, and management of the tuna industry. Much effort has gone into efficient use of available resources for sustainable crop/food production and supporting policy development for PNG's food security. PNG needs further support to strengthen existing R&D facilities and activities. It is therefore crucial, when designing projects, to include training and packaging of research results in a form suitable for uptake by farmers.

5.2 Relationship to the AusAID PNG strategy

AusAID's program supports broad-based sustainable economic growth in PNG by working with PNG government agencies and systems to ensure better use of PNG's own resources to strengthen economic management, deliver essential services and improve law and order. The importance of strengthening political governance, building sustainable government institutions, exploiting opportunities to stimulate sustainable economic growth and maintaining service delivery is recognised.

ACIAR's PNG program, which is delivered with significant long-term AusAID co-funding, supports the emphasis on fostering economic growth by working with PNG government agencies and systems. Partnership with PNG public and private sector institutions in agricultural research and development supports better use of PNG's own resources. With over 85% of the population in rural areas, development of agricultural industries and the smallholder cash economy is critical in stimulating sustainable economic growth and in maintaining service delivery.

5.3 Achievements

ACIAR's PNG program continued to emphasise research and development within four programmatic themes:

Applied research aimed to maintain and enhance smallholder incomes, with an emphasis on root, plantation, agroforestry and horticultural crops and aquaculture and effort to place these in a social and economic context, particularly with respect to:

- involvement of women farmers
- sustainable management of land, forestry and fisheries resources
- biosecurity
- institutional capacity building, socioeconomics and project assessment, through development of human and physical resources.

In attempts to enhance smallholder incomes from agriculture a project has aimed to improve the **marketing system for fresh produce** of the highlands of PNG. It has mapped the supply chain from the Highlands to the coastal markets, and this valuable new knowledge reveals how consumers form their preferences in the formal market in PNG. The adjacent box gives a more comprehensive picture of the work. This project and others have sought ways to lift the participation of youth and women, for their own benefit and also to improve productivity of commodities such as vegetables, peanut, cocoa, coconut and oil palm.

During the year progress was made in finding how to improve the capacity of **research and extension services in the cocoa sector**. Two public seminars held at the Cocoa and Coconut

Institute (**CCI**) and with the Cocoa Board in East New Britain (ENB) outlined the results of smallholder socio-economic studies and proposed recommendations to improve research and extension services. For example, New Guinea Island Producers (NGIP) of New Britain is servicing smallholders in ENB by providing planting materials, tools and extension advice. Thus, rather than limiting its activities to buying cocoa, as has been the case in the past, the company is now becoming more involved in supporting smallholders to raise productivity and increase or rehabilitate the area under cocoa production.

A project to facilitate farmer adoption of **new management strategies among cocoa smallholder farmers** through on-farm participatory action research (PAR) and village-based extension was disrupted by the discovery of the destructive Cocoa Pod Borer (CPB; *Conopomorpha crameriella*) in ENB. The PNG government declared a national state of emergency, resulting in a large-scale monitoring and eradication program. Despite the significant disruption caused by the CPB to this project, project activities and outcomes continued. An on-farm PAR-based approach termed Integrated Pest and Disease Management (IPDM) is being promoted to assist the adoption of the management strategies. Initial indications suggest that many are adopting them, particularly when they see the impact of the management changes. They are also learning to keep records of yield and disease levels in their cocoa blocks.

There has been a strong focus on **quality improvement and marketing enhancement for peanut**. Large-scale multiplication of selected varieties took place at Ramu Sugar to facilitate seed supply for on-farm trials. Eighteen trials in the Eastern Highlands, Upper and Lower Markham Valley, undertaken in collaboration with local farmer groups, evaluated new varieties and management practices on farmers' fields. Active participation of researchers and farmer groups strengthened linkages between the two groups, and substantial yield benefits were observed from the combination of improved varieties and improved practices across all sites. The improved varieties also proved more drought-resistant.

A survey conducted on the **role of women in peanut production** in Lower Markham Valley showed that peanut contributes 75% of total household income and women in the Lower Markham have two major roles in decision making—one relating to cropping (i.e. crop and variety, time of planting) and the other related to childcare. Women also play a major role in sourcing peanut seed, weeding, marketing and planting.

Efforts to lift **supply and quality of coffee** have been successful. A survey of the industry from farmer producer through processor, trader, buyer and consumer yielded a wealth of information that a research team then analysed to determine margins at each stage along the marketing chain. The team found that for green bean, growers with reasonable access to traders and processors (and therefore not hindered by high transport costs) were receiving reasonable prices. The team recommended that growers in reasonable proximity sell their main crop (May to July) direct to mills as ripe cherry which would lead to a final product equal to top estate coffee. A second, lighter crop around December/January was better processed by the farmers themselves, stored at home and used like a bank account to generate funds for immediate needs. The beauty of this arrangement is its harmony with Melanesian village life.

Inland aquaculture is regarded as a highly promising enterprise for villagers. In October 2002 fish farmers first received the genetically improved farmed tilapia (GIFT) strain of *Oreochromis niloticus* from the Highlands Aquaculture Development Centre at Aiyura in Eastern Highlands Province. This fish is a popular choice because of its ability to grow

rapidly and produce fingerlings in earthen ponds. An ACIAR project is developing commercial and farm-made feeds for tilapia and also the giant freshwater prawn (macrobrachium) in PNG and Fiji. The project team has reviewed the suitability of available ingredients (with their content analysis and costs), assessing aspects such as reliability of supply, cost, nutritional value and consistent quality, in order to formulate optimum low-cost diets. The project nutritionist has produced a basic feeds brochure for use by aquaculture extension officers and farmers in the participating countries and other Pacific Island Countries.

The PNG Feed Formula was used successfully in a miniproject involving cage **trials for culture of tilapia** at Yonki Reservoir in the PNG Highlands. A new ACIAR project, *Increasing capacity for regional fish feed manufacture in Papua New Guinea* has been developed as a result of these trials. In 2007 ACIAR has also published a monograph, *Aquaculture in Papua New Guinea*, outlining the issues facing the country and prospects for advancing village-based inland aquaculture.

ACIAR's strong focus on sustainable management of forestry and fisheries resources continued. One project undertook a **review of portable sawmills** in both PNG and Solomon Islands. Small-scale milling technology has allowed owners with rights to community forests to harvest from their own allotments, for their own purposes, in a way that was intended to maintain the resource for the long term. A project commissioned to examine current operations, define success and guide the further progress of portable mill technology sent an expert group on a two-week visit to small mills in PNG. The group concluded that problem areas were in the social, economic and regulatory fields, not in sawing technology which had been mastered quite well. Of particular concern was the poor regulation of small mill operation - mills harvesting less than 500 cubic metres per year were completely unregulated. Thus the legal position needed urgent revision. The formation of a Portable Sawmill Owners Association was recommended, for advice when recasting the regulations and to introduce some degree of self-regulation of activity.

Excellent progress has been made in activities to increase the availability and use of **improved germplasm for forestry and agroforestry** in PNG. In its second year of operation the project has focused on a range of species including sandalwood and teak. Seed orchards and clones banks (to enable rapid vegetative propagation of desirable species) have been established. Project partner organisations, in particular the Foundation for People Community Development (FPCD), provided six village communities with training in how to establish village nurseries. Each trainer has conducted follow-up training to reinforce and evaluate the implementation and impacts of nursery skills within their respective villages.

ACIAR is committed to the welfare of fisheries around PNG. Active projects include a survey of the biology and status of the **prawn stocks and trawl fishery** in the Gulf of Papua, and an assessment of the impact of the PNG purse seine fishery on tuna stocks. The **PNG tuna fishery** is the largest in the Pacific Islands region, and is based on total allowable catches allocated by species type (skipjack, yellowfin and bigeye tuna) and gear type (purse seine and longline). Tuna stocks appear to be declining, due in part to the use of anchored fish aggregation devices (FADs). The project team is providing information on tuna population dynamics and determining how FADs impact on the fishery.

Currently tuna stocks appear to be exploited at maximum levels of sustainability. PNG has a better chance of sustaining its tuna fisheries if it can encourage domestic fishing in the country's exclusive economic zone and phase out fishing by other nations. Responsibility for managing the fishery rests with the National Fisheries Authority, and it needs a framework to determine whether or not substituting domestic activities and the consequent loss of fees from other nations will confer net benefits to the economy. As part of this strategy an ACIAR project recently completed a survey to determine the labour cost component at a domestic cannery.

PNG must deal with a wide range of pests and diseases that affect both plants and animals. One particular scourge is **potato late blight**, which wiped out potato production in 2003. The favoured variety Sequoia is highly susceptible to the blight, and in order to keep the plants alive until maturity, the crop must be sprayed every 3 to 5 days with fungicides. Such an intensive regime may be too much for 'subsistence'

farmers, who once relied on potatoes as a valuable cash crop. This situation will not change until late-blight-resistant varieties are available. An ACIAR project aims to provide a consistent and assured supply of seed potatoes of current and new varieties for the market place. It has supported tests of several potato varieties developed by the International Potato Centre in Peru (CIP) that have proved to be very resistant to the blight. A tissue culture laboratory at Aiyura is being prepared to produce high numbers of quality potato plantlets as a forerunner of blight resistant Certified Seed Potatoes.

Sweet potato is the mainstay PNG's food security and accounts for 63 per cent of the dietary energy of the population. Climatic factors such as El Niño events can cause major but temporary falls in production, but aside from this farmers and scientists have noted a gradual decline in yields and the quality of tubers for no obvious reason. This decline has implications for food security and an ACIAR project is seeking solutions. The project, which aims to assemble better performing, disease-resistant germplasm, is introducing progeny-tested material from Australia or other sources. Viruses affect productivity, and the researchers are performing preliminary identification of virus and virus-like diseases. Aphids are common vectors of sweet potato viruses, and two aphid-proof tunnelhouses (igloos) have been imported - one to be used to propagate virus-free sweetpotato cuttings, the other for virus indexing. The project is profiting from advice from the International Potato Center (CIP) on virus detection and also directions for using tissue-cultured plants in heat treatment for virus removal (in-vitro thermotherapy).

The weed '**mile-a-minute**' (*Mikania micrantha*) has the capacity to smother food crops. A project is evaluating biological control through natural weed predators, based on known agents trialled or in use elsewhere. Another project is looking to control a planthopper, *Eumetopina flavipes* that earlier ACIAR work had identified as the vector of **ramu stunt disease** of sugarcane in PNG. This new research is developing an integrated pest management program for its control.

At present the main pest to coffee in PNG is **coffee green scale**. A project researching the best means for its control has taken the work of ACIAR socioeconomic researchers into consideration, because they have provided insights into the type of pest management acceptable and sustainable by smallholder growers. This is helpful in guiding development of the project's control packages. As well the team's work has discovered the serious threat posed by **coffee berry borer (CBB)**. Although not yet present it is just beyond the PNG border, and its arrival will mean that all farmers except those at the highest altitudes will have to invest more time in their crop if they are to get any sort of return from growing coffee.

Efforts continued to build up PNG's institutional and individual capacity. ACIAR finalised its project to introduce science communication in PNG. The '**SciCom**' project developed an applied accredited postgraduate course in scientific communication and developed the capacity of universities and their staff to deliver and manage the courses. Three PNG universities now have accredited post-graduate courses based on the developed modules.

The **ACIAR Scholarship Scheme** was initiated in the Department of Agriculture at Unitech at the beginning of the first semester in March 2005. Six scholars initially undertook postgraduate studies, studying topics such as the economics of peanut production, fish nutrition, fresh produce storage systems, yield decline in sweet potato, viral diseases of taro and host resistance to the sugarcane borer.

A further seven scholars started postgraduate programs in March 2006, undertaking studies with peanut farmers, researching the incidence of leptospirosis in local cattle, developing sources of traditional feed for pigs and fish (tilapia), genotype x environment interactions in taro, studies of vesicular streak disease of cocoa and virus detection in sweet potatoes. In the process of providing support for these scholars, a postgraduate computer laboratory was established and research funds supplied which permitted some upgrading of existing research facilities in the Department. In addition, all graduating scholars gained immediate employment in industries, research institutions and universities.

5.4 Advancing the vegetable trade out of the PNG Highlands

Growers in the PNG Highlands region can produce an amazing variety of high-quality temperate-zone vegetables year-round. They thrive in the mild climate and rich volcanic soils, and this bounty could meet the needs of PNG's populous coastal cities and maybe also supply overseas markets. For these reasons ACIAR commissioned a project back in 1983 that sought to find ways of developing a marketing system for Highlands produce.

The project team assessed transport methods and also studied factors affecting produce shelf life. Project team members Dr Kevin Scott, from the NSW Department of Agriculture, and Garth Atkinson, a New Zealander working with the PNG Department of Primary Industry, produced an ACIAR Technical Report (No. 14) outlining prospects for developing a marketing chain from the Highlands to populated coastal areas. That project's major achievements were to design a suitable refrigerated container and complete the testing of vegetable transport and handling from the Highlands to Port Moresby, using road containers between the Highlands and Lae, followed by ship to Port Moresby.

In 2001, during a visit to PNG, ACIAR program manager Ken Menz observed that this system had been taken up commercially in Mount Hagen in the Highlands, and had been operating for a number of years without government support. It was a major supply channel, competing with air freight and non-refrigerated surface transport. Aware of this success, the Fresh Produce Development Agency (FPDA) (a government instrumentality) wanted to encourage more operators into the business, but it was not simply a matter of slotting them in. The marketing system needed a holistic appraisal from the viewpoints of all its stakeholders before it was ready to expand.

Thus, in 2003 ACIAR commissioned another project, led by Professor John Spriggs of the University of Canberra. This time the research focused on socioeconomic change, involving all the people along the chain. The project's major aim was to help the stakeholders—representatives from along the supply chain including farmers, wholesalers, community associations, supermarkets, transporters, government agencies and researchers—come to the best decisions with regard to marketing Highlands fresh produce.

Through a process known as 'critical action research' stakeholders had opportunities to learn from the results of research conducted by the project team. They were also encouraged to contribute at project workshops and to become directly involved in the action plans drawn up for marketing system development and further research."

It became evident that there was a strong call to develop the physical infrastructure for marketing fresh produce. The stakeholders strongly supported the establishment of consolidation depots in the major highland centres of Goroka and Mount Hagen, served by satellite district depots in the surrounding production regions, and efforts have begun to put these in place. Attention is also being given to developing a quality-management system for the produce.

Village extension workers performed a valuable role. These are full-time farmers who act as conduits of technical and market information from the FPDA and other sources to farmers, and also relay production information from the farmers back to the FPDA. This process opened the eyes of farmers to the reality of markets previously unknown to them.

The marketing trials have also opened up opportunities that should lead to more young people staying on the land. They may also attract new people into farming to commence productive use of their land, and give existing farmers a reason to expand production.

6 Annual Operational Plan 2007–08

GNI per capita (\$US)	660	Bilateral actual 2005–06	\$ 4.70 m
Population	5.8 m	Bilateral estimate 2006–07*	\$ 4.73 m
Population 2015/2050	7.0/10.6 m	Bilateral budget 2007–08*	\$ 4.45 m
Active bilateral projects	34	Bilateral + multilateral budget 2007–08	\$ 4.83 m
Active multilateral projects	3		

*Includes AusAID-funded projects of \$2.1 m (forecast 2006–07) and \$1.87 m (budget 2007–08)

6.1 Key performance indicators (2007–08)

- Enhanced focus in project portfolio on improving the quality of commodities
- Maintain linkages between at least two ACIAR projects and projects funded under the new AusAID Agricultural Innovations Grants Scheme
- Greater involvement of PNG University of Technology in ACIAR's program
- Increased partnerships with other agencies promoting sustainable economic development, in particular the Ok Tedi Development Foundation and the PNG Sustainable Development Program
- Increased emphasis in ACIAR portfolio on sweet potato research and development, commensurate with its importance as a staple food
- Increased emphasis on promoting the role of indigenous nuts in local and export economies
- Stronger emphasis on enhancing the contribution of forestry to the national economy, in particular by linking commercial forestry to traditional agroforestry and community management of forests, and by strengthening domestic processing
- Extent of soil fertility decline of PNG highlands quantified and suitable research and development investments to improve soil fertility implemented
- Constraints to expansion of inland aquaculture identified and strategic planning for development commenced
- Increased capacity for regional fingerling and feed supply to underpin aquaculture expansion
- 40% of new projects designed to have significant farmer or policy-maker impacts within five years of completion.

6.2 Medium-term strategy

ACIAR's strategy in Papua New Guinea (PNG) is to support applied technical and economic research aimed at the enhancement of incomes for smallholders and the broader community. Emphasis is placed on the social and economic context of the research, particularly with respect to involvement of women farmers. There are emphases on plantation crops, root and other horticultural crops, forestry and fisheries. These include exported and domestically traded commodities that generate smallholder income and underpin improved food security and economic development. Project design encourages private sector, industry and non-government organisation (NGO) linkages. Through programmatic focuses on biosecurity and on sustainable management of land, forest and fisheries resources, sustainability of renewable resources is encouraged.

The PNG program has a strong emphasis on capacity building, with high priority given both to training within projects and postgraduate training. ACIAR will link closely with relevant AusAID programs, particularly the Agricultural Research and Development Support Facility. PNG has several significant competitive advantages in relation to the production of timber—available land, good soils and climate, and a long history of successful incorporation of trees into agroforestry systems. The opportunity exists to develop a timber growing and processing industry many times larger than the current log export industry from primary forests.

6.3 Position

Papua New Guinea is one of ACIAR's most important partners. ACIAR's investment and commitment in PNG reflects the deep, long-term relationship between the two countries. Overall, PNG is Australia's largest development partner. Australia is committed to seeing PNG develop and prosper. ACIAR's program in PNG has endeavoured to reflect this and, over recent years, the portfolio has increased significantly. Since 1998, AusAID, through a Record of Understanding, has provided ACIAR with an annual grant of \$2 million to fund agricultural research and development projects of mutual interest. In 2003, AusAID established the PNG Agricultural Innovations Grant Facility (AIGF), to support small projects in PNG agricultural research and extension institutions. Many of these projects relate to previous or current ACIAR-funded projects at these institutions. ACIAR will link closely with the new AusAID-funded PNG Agricultural Research and Development Support Facility.

Village-based agriculture supports 70–80% of the population, and domestic trading of fresh produce is a very important source of cash income. By far the most important crop in PNG is sweet potato. Other root crops are also important but well below sweet potato. The main export tree commodities are timber, oil palm, coffee, cocoa and coconuts. Domestic trading of fresh produce is a very important (and often under-recognised) source of cash income. Forestry is PNG's third largest revenue earner and a major contributor to the overall economic and social development of the country. PNG has several significant competitive advantages in relation to the production of timber—available land, good soils and climate, and a long history of successful incorporation of trees into agroforestry systems.

The PNG fisheries zone of 2.4 million square kilometres is the largest in the South Pacific. The fisheries zone includes an extended reef system, numerous islands and an extensive coastline. These create huge opportunity but also present an enormous challenge for monitoring and control. The total market value of the PNG catch is estimated at \$A140–160 million. Pigs and poultry are important village animals and there are some live exports of cattle from Papua New Guinea. ACIAR will assist in the development of capacity to detect and manage infectious disease in the wider context of biosecurity arrangements and in collaboration with other Australian agencies.

ACIAR's program recognises the many challenges to agricultural development in PNG, including poorly developed infrastructure, weak market signals and services, poor product quality, population pressure and future impacts of HIV/AIDS on the farming sector. Major changes to the rural environment over the last decade have included greater exposure to global markets, devaluation of the Kina, pressure on land and renewable resources as a result of population increases, and new pest and disease threats. These mean that as well as making a greater commitment to the implementation of the results of research, the need for on-going development of agricultural technologies remains strong.

ACIAR has funded some highly successful projects in PNG. Examples include control of the plant pest banana skipper and identification of the pheromone of cane borer (enabling its numbers to be monitored in the field), research on halting the spread of bee mites in PNG, conservation of indigenous plants, and management of the tuna industry. Much effort has gone into land-use planning and supporting policy development for PNG's food security. PNG's relative lack of resources and expertise is a constraint in R&D activities and in delivery of extension services. It is therefore crucial, when designing projects, to include training and packaging of research results in a form suitable for uptake by farmers.

6.4 Relationship to the AusAID PNG strategy

AusAID's PNG country program supports the Government of PNG's medium-term development strategy focus on sustainable broad-based economic growth in PNG by working with PNG government agencies and systems to ensure better use of PNG's own resources to strengthen economic management, deliver essential services and improve law and order. The importance of strengthening political governance, building sustainable government institutions, exploiting opportunities to stimulate sustainable economic growth and maintaining service delivery is recognised. In 2007-08 the focus of the program will be on improved governance and nation-building, sustainable broad-based economic growth and increased productivity (including from the agriculture, forestry and fisheries sectors), improved service delivery and stability, and responding to the HIV/AIDS crisis.

ACIAR's PNG program, delivered with AusAID co-funding, supports the emphasis on economic growth by working with PNG government agencies to improve agricultural productivity. Partnership with PNG public and private institutions in agricultural research and development supports better use of PNG's own resources. With over 85% of the population in rural areas, development of agricultural industries and the smallholder cash economy will be critical to drive broad-based economic growth and improve rural livelihoods in PNG.

6.5 Indicative priorities and current project portfolio

ACIAR has a formal program of consultations with PNG to establish priorities in research collaboration. These consultations are on a four-year rolling basis and were last held with PNG in September 2004; a record of the consultations is provided at www.aciar.gov.au under *Partner country priorities/Papua New Guinea*.

The consultation achieved consensus on several overarching issues. These include the roles of the private sector, industry bodies and NGOs along with government in research and implementation of research results, and the importance of research that assists the engagement of smallholders in the cash economy. In a discipline sense, the ACIAR PNG portfolio will emphasise agricultural economics (including after-harvest activities), farming systems, crop protection, fisheries and forestry.

The priorities are grouped under four programmatic themes:

- applied research aimed to maintain and enhance smallholder incomes, with an emphasis on root, plantation, agroforestry and horticultural crops and aquaculture (the social and economic context of the research is emphasised, particularly with respect to involvement of women farmers)
- sustainable management of land, forestry and fisheries resources

- biosecurity
- institutional capacity building, socio-economics and project assessment, through development of human and physical resources.

Subprogram 1: Enhancement of smallholder incomes from agriculture

A. Social and economic constraints and opportunities

- Research addressing social, economic and policy constraints and opportunities in smallholder production systems
- Market chain analysis (including quality incentives) for key commodities
- Analysis of international comparative market advantage of selected PNG agricultural commodities

B. Root and horticultural crops

- Conservation, characterisation and utilisation of plant genetic resources
- Improved productivity, nutrition and postharvest handling of products from smallholder farming systems, especially sweet potatoes and peanuts
- Management of pests and diseases of potato, sweet potato and other root crops
- Integrated crop management for highland vegetable production
- Maintenance of soil fertility with intensification of land use for annual crops

C. Tree crops

- Quality management, crop protection and marketing for cocoa and coffee
- Management of key insect pests and diseases of perennial fruit and tree crops and oil palm
- Maintenance of soil fertility in response to intensification of land use for plantation crops

D. Village-based aquaculture

- Enhanced productivity of existing inland pond aquaculture systems, and investigation of new opportunities including the domestication of indigenous species
- Assessment of market options and opportunities for aquaculture production
- Low-cost feeds and feeding systems for aquaculture

E. Forestry and agro-forestry systems

- Domestication and improvement of multiple-use, fast-growing indigenous tree species for smallholders and plantation development
- Processing of wood and non-wood products for value-adding and local industry development
- Improvement of traditional agroforestry systems, including fallow rotations, coffee, cocoa, vanilla cover crop management
- Development of non-timber forest products for communities

Subprogram 2. Sustainable management of forestry and fisheries resources

- Native forest management, including ecology of forest regeneration after logging growth and sustainable yield planning (with information and inventory systems) for forest harvesting
- Sustainable management for smallholder woodlots and industrial plantations, addressing soil and nutrient conservation, productivity decline, and forest pests and diseases
- Reforestation of degraded sites, including grasslands and mine sites
- Simple village-level mariculture options for enhanced livelihoods and provision of tools to support sustainable management arrangements for inshore fisheries resources
- Cooperation in the assessment and management of shared fish stocks in Torres Strait and the Gulf of Papua
- Review of policies and strategies for the tuna fishery
- Assessment of impacts of fish-attracting-device-associated tuna fisheries on resource sustainability, particularly the capture of juvenile bigeye and yellowfin tuna

Subprogram 3. Biosecurity policy and capacity enhancement

- Capacity building for identification, risk analysis and integrated management of plant pests, diseases and weeds
- Strengthening of surveillance systems to monitor and respond to livestock diseases

Subprogram 4. Institutional and individual capacity building

- Training priorities mainly addressed through targeted activities within projects
- Support for postgraduate degrees in Australia and an in-country scholarship scheme at Unitech, Lae
- Purpose-designed in-country courses in:
 - experimental design and statistical analysis, including management of data quality
 - research management, priority setting, monitoring and evaluation and impact assessment
 - scientific proposal writing and project design
 - presentation for scientific, extension, farmer and government audiences
 - collection and analysis of market information and training in extension approaches, including farmer participatory action research.

7 Projects (summary and progress reports)

7.1 Subprogram 1: Enhancement of smallholder incomes from agriculture

Projects:

A: Social and economic constraints and opportunities

Active

ASEM/2004/011	Evaluating domestic tuna fisheries projects
ASEM/2006/023	Re-commercialisation of the PNG pyrethrum industry and improving harvested yields in Australia
HORT/2006/055	Development in the ornamentals industry in the Pacific: an opportunity for income generation
LPS/2005/094	Improving the profitability of village broiler production in PNG
SMCN/2004/041	Productivity and marketing enhancement for peanut in Papua New Guinea and Australia

Concluded

ASEM/2001/037	Improving the marketing system for fresh produce of the highlands
ASEM/2002/050	Economic performance and management of the Gulf of Papua prawn fishery

Pipeline

ASEM/2006/035	Improving marketing efficiency and post harvest handling of sweet potatoes in PNG
ASEM/2006/127	Private sector/smallholder partnerships for improving incomes in oil palm and cocoa sectors in Papua New Guinea
ASEM/2006/129	Early warning for low rainfall periods and preparedness for crop management and storage
FST/2006/048	Improved processing, storage and packaging of Canarium nuts
PLIA/2005/149	A comparison of policy environments for cocoa technology adoption and industry development in Bougainville and other parts of PNG
PLIA/2006/004	Road improvement in PNG and implications for adoption of research outcomes for coffee growers

B: Root crops

Active

CP/2000/044	Taro beetle management in PNG and Fiji
CP/2003/029	Management of potato late blight in PNG
CP/2004/071	Reducing pest and disease impact on yield in selected PNG sweet potato production systems
HORT/2005/134	The use of pathogen-tested planting materials to improve sustainable sweet potato production in Solomon Islands and Papua New Guinea (CIP)(Multilateral)
HORT/2006/106	Screening and field trials of high-carotenoid sweet potatoes for improving the vitamin A status of residents of the Solomon Islands and Papua New Guinea
SMCN/2003/010	Farmer evaluation and multiplication of sweet potato varieties on the north coast of PNG
SMCN/2004/067	Management of soil fertility in sweet potato-based cropping systems of the PNG Highlands

Concluded

CP/2002/013	Biology, damage levels and control of red-banded mango caterpillar in Papua New Guinea and Australia
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Pipeline

- ASEM/2006/035 Improving marketing efficiency and postharvest handling of sweet potatoes in PNG
- SMCN/2007/040 Grain legume crops in PNG highlands

*C: Tree crops***Active**

- ASEM/2001/016 Microbial contaminants associated with sago processing and storage in Papua New Guinea
- ASEM/2002/014 Improving productivity and the participation of youth and women in the Papua New Guinea cocoa, coconut and oil palm industries
- ASEM/2003/015 Enhancing PNG smallholder cocoa production through greater adoption of disease control practices
- ASEM/2004/017 Assessment and improvement of quality management during postharvest processing and storage of coffee in PNG
- ASEM/2004/042 Assessing and extending schemes to enhance incomes of PNG smallholder coffee producers via price premiums for quality
- ASEM/2004/047 Sustainable management of coffee green scale in Papua New Guinea (CABI)(Multilateral)
- ASEM/2006/033 PNG coffee project coordinator
- CP/2004/064 Biological control of 'mile-a-minute' (*Mikania micrantha*) in PNG, Fiji and Australia
- SMCN/2000/046 Overcoming magnesium deficiency in oil palm crops on volcanic ash soils of PNG
- SMCN/2006/031 Analysis of nutritional constraints to cocoa production in PNG

Concluded

- PLIA/2005/148 Papua New Guinea coffee and cocoa policy linkages scoping study
- PLIA/2007/019 A review of the future prospects for the world coconut industry and past research in coconut production and product development: Implications for ACIAR's future directions for coconut research

Pipeline

- ASEM/2006/127 Private sector/smallholder partnerships for improving incomes in oil palm and cocoa sectors in Papua New Guinea
- PLIA/2005/149 A comparison of policy environments for cocoa technology adoption and industry development in Bougainville and other parts of PNG
- PLIA/2006/004 Road improvement in PNG and implications for adoption of research outcomes for coffee growers

*D. Village-based aquaculture***Active**

- FIS/2001/083 Inland aquaculture in PNG: improving fingerling supply and fish nutrition for smallholder farms
- FIS/2004/065 Increasing capacity for regional fish feed manufacture in Papua New Guinea
- FIS/2006/138 Developing aquaculture based livelihoods in the Pacific Islands region and northern Australia

Concluded

- FIS/2001/075 Sustainable aquaculture development in Pacific Islands region and northern Australia
- FIS/2006/001 Culture of promising indigenous fish species and bioremediation for barramundi aquaculture in northern Australia and PNG

E. Forestry and agro-forestry systems

Active

FST/2003/049	Review of portable sawmills in the Pacific: identifying the factors for success
FST/2004/009	Facilitating the availability and use of improved germplasm for forestry and agroforestry in PNG
FST/2004/050	Value-adding to PNG agroforestry systems
FST/2004/055	Domestication and commercialisation of <i>Canarium indicum</i> in Papua New Guinea

ASEM/2004/011: Evaluating domestic tuna fisheries projects

Bilateral

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	University of Queensland, School of Economics, Australia
Project Leader	Professor Harry Campbell Phone: 07 3365 6570 Fax: 07 3365 7299 Email: h.campbell@economics.uq.edu.au
Collaborating Institutions	National Fisheries Authority, Papua New Guinea Forum Fisheries Agency, Solomon Islands
Project Budget	\$331,435
Project Duration	01/04/2005 to 31/03/2008
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Access fees paid to Papua New Guinea (PNG) from other distant water fishing nations grant these nations a right to fish in PNG's exclusive economic zone. Fees from the exploitation of these waters account for around 2 per cent of PNG Government revenue. Recently, however, domestic fishing interests have begun to exploit PNG's tuna fisheries as a basis for income, food security and employment. These fisheries are currently being fished at the maximum level of sustainability; increasing catches will create pressure on tuna stocks that may be unsustainable. If the tuna fisheries are to remain sustainable the line between domestic and distant water fishing fleets must be redrawn.

The National Fishery Authority is responsible for managing the tuna fisheries and their sustainability. But will domestic activities bring net benefits to the PNG economy as they slowly replace distant water fishing nations' access fees? The PNG Government has adopted a policy to support the gradual domestication of the tuna industry in the hope of generating a wider range of returns. Building a framework, beginning with an existing model, in which to assess benefits from domestication is needed.

The project will support this by increasing the capacity of NFA, and other agencies, to perform independent economic analysis of proposed domestic tuna fisheries projects.

This will be achieved by:

- modifying an existing evaluation framework and apply the framework to measure the private and social net benefits of a locally-based tuna operation in PNG

- generalising the framework to be relevant for analysis of policy decisions regarding domestication of tuna and other industries.

Project Progress

Year 2 (01/04/2006–31/03/2007)

The results of the RD Cannery labour force survey were analysed and two papers presenting the analysis were completed. A significant result of the analysis was the estimate of the shadow-price of labour which is a key variable in the benefit-cost model of the cannery. A draft version of the benefit-cost model was completed and the methodology and results were discussed in a series of papers. Three conference and seminar papers were prepared and presented. The Australian project leader met with the NFA and FFA project personnel in Port Moresby October 24–26 and conducted three workshops on the benefit-cost model.

These workshops introduced the developing-country partners to the methodology, format and results of the model and provided the project leader with valuable suggestions for changes to reflect the situation and needs of the developing countries. In addition to the three project leaders (Ronald Kuk, Len Rodwell and Harry Campbell), the workshops were attended by seven staff from NFA, one each from FFA, the Department of Trade and Industry, the Investment Promotion Authority, the Rural Coastal Fisheries Development Program, the National Research Institute and the University of PNG. Following the workshops the model was revised and made available on the project website.

ASEM/2006/023: Re-commercialisation of the PNG pyrethrum industry and improving harvested yields in Australia

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Botanical Resources Australia - Agricultural Services Pty Ltd, Australia
Project Leader	Mr Brian Chung Phone: 03 6224 4511 Fax: 03 6224 4473 Email: bchung@botanicalra.com.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Enga Provincial Administration, Papua New Guinea University of Tasmania, Australia Department of National Planning and Monitoring, Papua New Guinea
Project Budget	\$801,657
Project Duration	01/01/2007 to 31/12/2010
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Pyrethrum is an in-demand insecticide extracted from the *Pyrethrum* daisy plant. Its benign properties make it desirable for use as an insecticide in a number of applications. Introduced to PNG in the late 1950s it formed a major highland industry employing as many as 80,000 people in the late 1980s. Local products were sold to a processing factory with marketing undertaken by the factory owners.

The closure of this factory ended the local market, curtailing the industry. Botanical Resources Australia has offered to buy the PNG crop and help re-commercialise the industry. The project will involve supply of planting materials and instruction in improved agronomic practices, together with research into the adoption of improved production of pyrethrum and study of plant physiological factors.

Project Progress

First progress report due in 2008.

HORT/2006/055: Developing the ornamentals industry in the Pacific: an opportunity for income generation

Bilateral

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Secretariat of the Pacific Community, Fiji
Project Leader	Dr Mary Taylor Phone: 679 3370733 Fax: 679 3370021 Email: maryt@spc.int
Collaborating Institutions	Trade and Development Office, Fiji South Seas Orchids, Fiji Mary Elzs Orchid In Bloom Ltd, Papua New Guinea
Project Budget	\$96,300
Project Duration	01/01/2007 to 31/12/2007
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

There is enthusiasm for cut flowers in the main towns of most Pacific Island countries, but as an industry, floriculture is very much in the developmental stage, and focused on the local market. The primary aim of this project is to evaluate the market opportunities that exist for a thriving floriculture industry in two Pacific Island countries - Fiji and Papua New Guinea.

The project will also identify the main constraints (for example, pests and diseases, limited skill levels, poor quality, limited packaging and storage technology) that would hinder the development of the floriculture industry in the two countries, and make recommendations to address the constraints.

Project Progress

First progress report due in 2008.

LPS/2005/094: Improving the profitability of village broiler production in PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	South Australian Research and Development Institute, Pig and Poultry Production Institute, Australia
Project Leader	Dr Phil Glatz Phone: 08 8303 7786 Fax: 08 8303 7689 Email: glatz.phil@saugov.sa.gov.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea University of Technology, Papua New Guinea Christian Leaders Training College, Papua New Guinea Lutheran Development Service, Papua New Guinea Salvation Army Agricultural Development Program, Papua New Guinea
Project Budget	\$399,950
Project Duration	01/01/2007 to 31/12/2009
ACIAR Research Program Manager	TBA

Project background and objectives

The village broiler farming sector in PNG imports most feed ingredients, despite a doubling in production costs due to massive devaluation of the Kina and transportation cost rises. Suitable local alternatives, such as copra meal, fishmeal and palm kernel meal are available.

Project LPS/2001/077 developed a supplement of fishmeal and copra meal (plus minerals and vitamins) which when combined with 50-80% of local ingredients (e.g. sweet potato) makes up a whole ration. This project builds on this work to improve broiler production and profitability, developing on-station a range of best-bet feeding options, evaluating on-farm feeding options incorporating local feeds, and promoting their wide-spread adoption.

Project Progress

First progress report due in 2008.

SMCN/2004/041: Productivity and marketing enhancement for peanut in Papua New Guinea and Australia

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Rao C N Rachaputi Phone: 07 4160 0737 Fax: 07 4162 3238 Email: rao.rachaputi@dpi.qld.gov.au
Collaborating Institutions	Ramu Sugar Ltd, Papua New Guinea National Agricultural Research Institute, Papua New Guinea Trukai Industries, Papua New Guinea Department of Agriculture and Livestock, Papua New Guinea
Project Budget	\$844,422
Project Duration	01/01/2006 to 30/06/2009
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

As a part of the ACIAR project 'Improving Yield and Economic Viability of Peanut Production in PNG and Australia' (ASEM 2001/55) the critical role of peanuts in PNG farming systems was documented and high-yielding peanut germplasm lines from ICRISAT were introduced and evaluated in multi-location trials in PNG.

These trials resulted in identification of promising varieties with potential to yield 50–100% greater than the local varieties. The next logical step is to transfer the new varietal and associated management technologies to smallholders and also to enhance the markets for, and marketability of, new peanut varieties in PNG.

The Australian peanut industry has highlighted a need to assess the potential for markets for new peanut varieties and their products (i.e. especially high-oleic acid peanut oil which is comparable to sunflower oil).

In Australia, spatial variability for yield and quality on broadacre farms is one of the major constraints to improving yield and profitability of commercial varieties. Recent work at DPI&F indicated that Near Infrared Reflectance (NIR) captured from aerial and satellite platforms can be effectively used to identify and monitor spatial variability (for disease, crop growth and maturity, and aflatoxin risk) in peanut crops and to implement novel in-season management and

harvesting strategies. NARI and Ramu Sugar are keen to apply this technology. In PNG, the application is more likely to be in terms of monitoring peanut crops (and other cropping systems), rather than intensive real time management, as is intended for Australia.

The objectives of the project are to:

- Ensure multiplication and supply of seeds of new high yielding peanut varieties to smallholders in Morobe and Eastern Highland Provinces of PNG
- Demonstrate and monitor improved productivity of peanut using varietal, management, modelling technologies and farmer-participatory research approach in PNG
- Develop and apply aerial NIR remote sensing technology to monitor spatial variability and improve productivity of peanut in Australia and investigate the scope for applying the NIR technology to monitor peanut cropping systems in PNG
- Assess the potential of and feasibility to enhance marketability of new peanut varieties and products in PNG and Australia.

Project Progress

Year 1 (01/01/2006–31/12/2006)

The project has made significant progress in several areas, and highlights of outputs to date are summarised below:

Objective 1

During the 2005–06 peanut growing season, large-scale seed multiplication of selected peanut varieties was undertaken at Ramu Sugar to facilitate seed supply for the on-farm trials in the Eastern Highlands, Upper and Lower Markham Valley regions. National Agricultural Research Institute (NARI) has made arrangements with Ramu Sugar to procure the pure seed of all peanut varieties for long-term storage at NARI HQ at Bubia and Aiyura.

Objective 2

During the 2005–06 season the PNG collaborating institutions, i.e. NARI, Ramu Sugar and Trukai Industries, conducted a total of 18 on-farm trials in the Eastern Highlands, Upper and Lower Markham Valley, in collaboration with local farmer groups, to evaluate new varieties and management practices on farmers' fields. Active participation of researchers and farmer groups in the on-farm trials resulted in the strengthening of linkages between farmers and collaborating research institutions.

Substantial yield benefits were observed from the combination of improved varieties and improved practices across all sites, with the yield benefits ranging up to 100% in Eastern Highlands and to 60% in Markham Valley. Local varieties with improved practices also gave up to 40% higher yields than the local varieties grown with local practice at most sites. However, yield advantages from the improved varieties alone (with local practices) were variable across sites. The trials have clearly demonstrated the scope for improving peanut production at smallholder level in PNG.

At the locations which experienced severe end-of season droughts (Lower Markham Valley), the improved varieties have yielded significantly better than the local varieties by escaping end-of season droughts, demonstrating the better adaptability of short-duration varieties to drier environments.

Peanut field shows and grower meetings organised by the project teams have generated significant awareness amongst growers about the new peanut varieties and management practices, including the harmful effects of aflatoxin contamination.

Mini-column equipment for aflatoxin analysis has been installed at NARI, Aiyura in Eastern Highlands and Ramu Sugar (Upper Markham Valley) research stations. Project staff from NARI, Ramu Sugar and Trukai Industries received hands-on training on the mini-column technique. Following the training, project staff have been able to conduct aflatoxin analysis of peanut samples collected from the seed village trials. It is expected that the capacity-building for aflatoxin analysis should result in effective monitoring of aflatoxin contamination and development of aflatoxin minimisation practices.

A survey conducted on the role of women in peanut production in Lower Markham Valley showed that peanut contributes 75% of total household income and women in the Lower Markham have two major roles in decision-making, one relating to cropping (i.e. crop and variety, time of planting) and the other related to childcare.

Women also play a major role in sourcing peanut seed, weeding, marketing and planting. The survey has identified four major training needs for women i.e., soil fertility, bookkeeping, pest/disease control and new strategies for peanut marketing.

Objective 3

The analysis of the satellite images of a peanut-growing area in the Upper Markham region demonstrated that peanut crops could be distinguished from other land-cover types based on the differing Infra Red reflectance from peanut canopies.

A comparative analysis of two satellite images showed that the QuickBird imagery is superior to IKONOS. However, the IKONOS satellite orbits over PNG at a 2-day interval as opposed to 7 days for QuickBird, which means that in the event of >10% cloud cover over the target area (very common for PNG) a re-attempt at the capture can occur within a shorter period of time with IKONOS.

Although the image analysis technology has proven successful in identifying peanut crops and assessing the crop vigour, the constant cloud cover that shrouds PNG created some concern on the future effectiveness of satellite imagery technology in this region, although this was alleviated to some degree by the repeat frequency of the IKONOS satellite.

In Australia, a high-resolution QuickBird satellite image was acquired over the southern Queensland township of Wooroolin in March 06. Application of advanced Image Analysis techniques in conjunction with the ground-truthing of crops showed that the remote sensing has the capacity to not only directly identify the spatial variability of crop vigour but also derive accurate predictions of pod yield and maturation level from variations in canopy reflectance. This information can provide a grower with the ability to assess spatial distribution of yield prior to harvest as well as make more informed decisions regarding harvest management.

Objective 4

After extensive consultations with the PNG and Australian Peanut Industry stakeholders, a strategic document outlining the peanut industry needs and expected outcomes of the proposed market study has been developed. A suitable consultant with wide experience in PNG and Australian Peanut Industry as well as global peanut market has been identified. It is expected that the scoping study reports for PNG and Australian peanut Industries will be available by the end of March 07.

ASEM/2001/037: Improving the marketing system for fresh produce of the highlands of PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Canberra, Australia
Project Leader	Professor John Spriggs Phone: 02 6201 2317 Fax: 02 6201 2263 Email: jspriggs1@gmail.com
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Fresh Produce Development Corporation, Papua New Guinea University of Technology, Papua New Guinea
Project Budget	\$620,134
Project Duration	01/01/2003 to 30/06/2007 (Project extended from 01/01/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

The Papua New Guinea (PNG) highlands, home to about one-third of the national population, is characterised by subsistence agriculture and rural poverty. Soils are rich and productive. High-quality produce can be grown organically all year round in this area and produce from the highlands could meet the needs of PNG's coastal cities and supply offshore markets.

It fails to do so because of an inadequate marketing system. Marketing is made difficult by the long and complex supply chains between producing and consuming regions, and there is a growing trend for supermarkets to source their fresh produce from offshore.

An effective marketing system for fresh produce could provide a cash income, empower women (who are mainly responsible for the cultivation) and significantly improve the economic situation of PNG's highlanders. Improving the marketing system for produce from the highlands is a high priority of the National Food Security Policy of the PNG Government, and two producer groups have already been formed in the Highlands by farmers keen to improve their marketing of fresh produce.

The project is improving the marketing system for fresh produce grown in the temperate zone of the PNG highlands, by facilitating processes that will improve the supply chains by land, air and sea, and by enhancing the capacity of relevant people and institutions in PNG.

Project Progress

Year 4 (01/01/2006–31/12/2006)

The project made the following progress in Year 4:

Market infrastructure development

This was identified early on in the project as the number one priority by stakeholders in the fresh produce marketing system. As a result, our research team developed a concept paper in 2004 for market infrastructure development in the Eastern Highlands Province involving a consolidation depot in Goroka (the provincial capital) and four satellite district depots in the major producing areas. This was submitted to the PNG Incentive Fund and the National Government for funding and was approved in principle by both. This was followed in 2005 by preliminary investigations and negotiations by FPDA staff to obtain title to the land needed for the depots. These negotiations proved to be quite difficult particularly for the consolidation depot and resulted in our research team developing a new proposal in late 2005 to move the consolidation depot from Goroka to Kainantu.

CONCLUDED PROJECTS

The FPDA Board approved this change and following protracted negotiations an acceptable lease arrangement was reached in late 2006. FPDA has also reached acceptable lease arrangements for three of the four sites proposed for the district depots. Construction of the consolidation depot is planned to commence in May 2007 using funds from the National Government. It was envisaged that funds for the district depots would come from the PNG Incentive Fund. However, because of the prolonged uncertainty with respect to land acquisition, this funding source has apparently lapsed.

Quality Management

In 2006, a sub-project on quality management was established with the Food Science Department of Unitech, aiming to improve quality management in fresh produce supply chains. One facet of this project is to develop protocols for a whole-of-supply chain quality management program along fresh produce supply chains. The project worked with a specific case study of a tomato supply chain from Goroka to Lae. A progress report on this sub-project has been completed with final report due at the end of June 2007.

Evaporative Cooler Technology

A sub-project to explore the potential for low-cost evaporative cooler technology was established with the Agriculture Department at Unitech. This involved construction of an evaporative cooler room at the University of Goroka farm and testing the shelf life of different types of fresh produce. An interim report has been produced, with final report due by the end of June 2007. The researchers found that the evaporative cooler successfully kept produce about 5°C cooler on average than ambient temperature, but more importantly the temperature remained much more constant. This had a significant effect on extending shelf life of the produce involved.

Communications Technology (two-way radios)

In 2006, a sub-project to evaluate the use of two-way radios in the Highlands was established with FPDA. Interviews were carried out with users of two-way radios (TWRs) in Simbu and Western Highlands Province with a view to determining whether their use should be expanded within FPDA. In their final report, the researchers noted that users found the TWRs very useful as a communications device and they highly recommended expanding their use in FPDA.

Postharvest Resource Manual

In 2006, a sub-project was established with FPDA to write a resource manual covering the basics of postharvest management of fresh produce in a PNG context. The objective was to produce an extension aid for farmers and other participants of the fresh produce marketing system. The final draft is scheduled for completion in March 2007 and it is then planned to publish it through ACIAR.

Improved understanding of buyer preferences

This sub-project was established with NARI in 2005 to build up an understanding of the preferences of buyers in the formal and informal markets in the major urban centres, Lae and Port Moresby. During 2005 the focus was on improving our understanding of the preferences of consumers who purchase at supermarkets. During 2006, the focus shifted to a study of the preferences of supermarket managers and institutional buyers as well as a study of the preferences of consumers who purchase in the informal markets. Both studies have been written up in reports and the results of the study of supermarket managers and institutional buyers have been presented at an international development conference (DEVNET 2006 in November 2006). Among other things, this paper shows significant differences between supermarket managers' perceptions of what their customers want and what their customers actually said they wanted.

Airfreight Shipments

During 2006, FPDA attempted to commercialise the airfreight shipments that we began as part of our project in 2005. During the 2005 airfreight trials, we showed that air shipments of fresh produce from the Goroka area to Port Moresby were commercially viable, but that it required careful management (of both the produce and the finances) to succeed. The 2006 airfreight shipments were managed by FPDA on a cost-recovery basis.

Women and Youth

This sub-project was established with FPDA in 2005 and continued into 2006. In 2005 the focus was on improving participation of women in the supply chain, while in 2006 the focus turned to youth. There was a strong perception among the stakeholders that encouraging more youth participation in the production and marketing of fresh produce would help to reduce the drift of youth to the cities. The youth study began with a literature review and key informant interviews. This led to the development of a concept paper and assistance with a national youth survey (stimulated by our project). Our project has provided part of the funding for the youth survey and is assisting in the analysis of results.

ASEM/2002/050: Economic performance and management of the Gulf of Papua prawn fishery

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Australian National University, National Centre for Development Studies, Australia
Project Leader	Dr Thomas Kompas Phone: 6125 6566 Fax: 6125 5570 Email: tom.kompas@anu.edu.au
Collaborating Institutions	National Fisheries Authority, Papua New Guinea
Project Budget	\$269,487
Project Duration	01/07/2003 to 30/06/2007 (Project extended from 01/07/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

The Gulf of Papua Prawn Fishery (GPPF) is one of Papua New Guinea's most important fisheries. It provides a total annual catch of about 1000 tonnes, worth K\$10 million. Catch rates are low, largely due to the small number of vessels and their age. Fishing in the Gulf is overseen by the National Fisheries Authority (NFA), which recently allocated 10 new licences for a small inshore prawn fishery.

Little is known about the potential biological and economic impacts of the uptake of these licences. Crucial to this is the relationship between inshore and offshore components of the prawn population. NFA managers will be better placed to plan for sustainable management based on the best options, both economic and biological, with this knowledge.

A previous ACIAR-supported project recommended a cap on industrial fishing and a change from management by Total Allowable Catch to Effort targets. This is essential to managing the fishery, as is a greater understanding of the fishing power of the current and replacement fleets.

The project is analysing the economics of the GPPF fishery and the industry to:

- document their economic status
- assess economic performance
- develop and evaluate management and policy options
- assess the impact of a small boat (inshore) fishery on the Gulf of Papua prawn fishery.

Project Progress

Year 4 (01/07/2006–30/06/2007)

Annual report not yet submitted by the Commissioned Organisation.

CP/2000/044: Taro beetle management in PNG and Fiji*Bilateral*

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Secretariat of the Pacific Community, Fiji
Project Leader	Mr Aleki Sisifa Phone: +679 337 9214 Fax: 679 3370021 Email: alekis@spc.int
Collaborating Institutions	CSIRO Entomology, Australia Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, Papua New Guinea
Project Budget	\$853,855
Project Duration	01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Taro is the preferred staple in Pacific communities. One of the main pests of taro is the taro beetle, which damages the corm (an underground stem resembling a bulb) of the plant and creates entry points for secondary pests. The taro beetle causes about 30 per cent yield loss in taro-producing countries such as PNG and Fiji.

Taro is a labour-intensive crop which is grown on a small scale in farming communities. The spread of the taro beetle in the Pacific is a threat to taro exporters and their revenue, and it also has an environmental impact because infested taro gardens are abandoned and lead to clearing of established forests for new gardens.

For Australia, the use of a fungus such as *Metarhizium* for biological control is attractive, because such fungi specifically target the pest, occur naturally and often give persistent control in the soil. However, the use of mycoinsecticides in Australia has been slow because of the lack of suitable products and the high costs. To improve this situation, more research is needed for better understanding of strain selection, mass production, formulation and application strategies.

This project is developing biological controls for the taro beetle, including investigating the combined action of pesticide control and bio-control. It will implement these methods for taro beetle management in environmentally sustainable cropping systems in Papua New Guinea (PNG) and Fiji.

These practices will reduce taro beetle damage in farmers' fields, restore the supplies of taro as a major staple and revive the trade in quality taro in infested countries. This project relies upon bio-control methods that were identified during a previous project that studied the fungus *Metarhizium anisopliae* (Ma), and the virus *Baculovirus oryctes* (OrV).

Project Progress**Year 5 (01/01/2006-31/12/2006)**

The Taro Beetle Management (TBM) program commenced officially on 1 January 2002 for duration of 4 years as a component of SPC Pest Management in the Pacific (PMP) program. PMP, funded jointly by Australia (AusAID and ACIAR) and New Zealand (NZAID), is one of the two major projects of SPC-Plant Protection Service.

The other project is Plant Protection in the Pacific (PPP), funded by European Union (EU). PPP commenced on 1 January 2002 for 4 years. Additional taro beetle activities outside PNG and Fiji are funded by EU-PPP.

The first phase of the project ended in 2005. The end-of-project review recommended a two year extension to complete the following activities:

1. Conduct participatory adaptive research with the objective of integrating the results of the applied research of Phase 1 into sustainable farming systems management practices.

ACTIVE PROJECTS

2. Complete unfinished studies on taro beetle management, and on the intricacies of the recommended insecticides, insecticide/biocontrol synergy work, etc.

All activities planned for 2006 were carried out smoothly. The highlight of the project activities was the official launch of the control recommendations in Fiji and Vanuatu. The PNG launch, which was supposed to take place in October, was postponed until early 2007. The main activities conducted in 2006 are listed below.

Activities in PNG:

- Trial: fertiliser trial (Keravat), Objective: determine fertiliser rate for taro in the taro growing areas in PNG
- Trial: synergy trial (Keravat), Objective: determine the synergy effect between Ma & Imidacloprid insecticides (Mustang & Confidor)
- Trial: on-farm trial (backyard) Keravat, Objective: evaluate recommended insecticides under different environmental conditions
- Trial: backyard trials (institutions in Keravat and surrounding areas), Objective: demonstrate taro beetle control practices at these institutions.

All the trials have been harvested. The data have been sent to a biometrician to analyse and interpret the results.

Activities in Fiji:

- Four sites (Navua, Naitasiri, Tailevu and Ovalau) were selected for the demonstration of control measures.
- The team conducted TBM FFS – three sessions at each site (at planting, 2nd application of treatments & at harvest).
- At Navua the TBM control recommendations were launched in July. The launching was done conjointly by the Fiji Ministry of Agriculture and SPC.

- The team planted and harvested four TBM trials (planting method verification – Navua & Waibau; Ma/confidor synergy - Sote & chemical residue analysis in Fiji – KRS farm).
- Three observational plots in Fiji (Lobau, Baulevu & Waibau) were established for assessing confidor & bifenthrin.

All activities were carried out without any major problem. The field demonstrations were carried very successfully with good turnouts of the taro farmers in each locality.

The launching was a very successful event of the year where over 500 farmers, industry people, representatives of diplomatic missions and government people attended. All major media gave good coverage of the launching. It generated a lot of enthusiasm among the taro growers, particularly over various measures implemented to control taro beetle.

CP/2003/029: Management of potato late blight in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Department of Primary Industries, Victoria, Knoxfield Centre, Australia
Project Leader	Rudolf De Boer Phone: 03 9210 9222 Fax: 03 9800 3521 Email: dolf.deboer@dpi.vic.gov.au
Collaborating Institutions	CRC for Tropical Plant Protection, Australia International Potato Center, Peru National Agricultural Research Institute, Papua New Guinea Fresh Produce Development Company Ltd, Papua New Guinea Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea
Project Budget	\$918,109
Project Duration	01/11/2004 to 31/10/2009
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Potatoes are an important cash crop in Highland provinces. Commercial trade had reached 15,000 tonnes annually with a total value of Kina 10-15 million. This trade involved smallholders, many of who also rely on potato as a food staple and income source. Barter trade in potatoes is also widespread. An outbreak of potato late blight in early 2003 began destroying potato crops throughout the Highlands region. The cause is believed to be a virulent and new strain or strains of *Phytophthora infestans*, found in other potato-growing regions throughout the world but not in PNG prior to the outbreak.

The highlands climate is ideal for late blight, making control regimes vital, and also expensive. Fungicide spraying is needed every 3-5 days during potato cropping but the chemicals and equipment are beyond the purchasing power of most smallholders. Ensuring potatoes remain a viable crop for smallholders will depend on finding new seed stock that is resistant to blight, and/or effective and inexpensive control regimes.

The project is working towards these aims, specifically by:

- introducing, multiplying, evaluating and deploying late-blight-resistant potato clonal material into Papua New Guinea

- developing safe and cost-effective integrated late blight management strategies for existing and new potato cultivars.

Project Progress

Year 2 (01/11/2005–31/10/2006)

There is renewed confidence in potato production in PNG following the epidemic of potato late blight that wiped out potato production in 2003. Quantities of locally grown potatoes of the favoured variety Sequoia can be found in the market places of major centres in PNG. For the moment it seems that potatoes are grown mostly by a small number of 'commercial' farmers who can afford the seed, chemicals and labour.

They have learnt from the results of field trials conducted through this project, and from their own experience, how to manage late blight in the highly susceptible Sequoia. In order to keep the plants alive until maturity, the crop must be sprayed every 3 to 5 days with fungicides. The average crop receives 12 to 20 fungicide sprays throughout its lifetime, an intensive regime that may be too much for 'subsistence' farmers who once relied on potatoes as a valuable cash crop. This situation will not change unless late-blight-resistant varieties are made available.

ACTIVE PROJECTS

One of the objectives of the project is to establish late-blight-resistant cultivars in PNG. It should be possible to grow resistant cultivars with significantly less chemical treatments than the current variety. Several potato varieties developed by the International Potato Centre in Peru (CIP) were tested in the field by National Agricultural Research Institute (NARI) scientists and proved to be very resistant to potato late blight. In these trials, a number of varieties showed no sign of disease throughout the life of the crop, whereas the susceptible Sequoia died within weeks of planting.

A selection of these varieties is now being multiplied in tissue culture by NARI and will be grown on as seed potatoes by the Fresh Produce Development Agency for distribution to selected growers for further testing. In the meantime, several additional CIP varieties will be screened for disease resistance so that further selections can be made. This will ensure the availability of several varieties in the market place over the next few years.

Potatoes cannot be grown in PNG without fungicide treatments. An objective of the project is to identify cost-effective and safe chemical treatments to control late blight. Fungicide products containing copper or chlorothalonil are being currently used by farmers.

In recent trials, spray treatments with chlorothalonil were superior to treatments with copper and significantly delayed the onset of late blight in the crop. In trials that tested how often a crop needed treatment for effective disease control, chlorothalonil treatments applied no less than every 7 days resulted in the best yields. In contrast, crops sprayed with copper every 7 days did not reach maturity.

Reliance on one fungicide for potato late blight control is not sustainable. An alternative, the systemic fungicide potassium phosphonate, has shown promise in controlling late blight in a number of countries around the world. It is available in PNG (Agri Phos 600®) and has registration for potato late blight control. This fungicide is relatively cost-effective and safe to use. It will be trialled in the field and integrated with the protectant fungicide chlorothalonil.

An important project objective is the consistent and assured supply of seed potatoes of current and new varieties into the market place. The tissue culture laboratory at Aiyura is critical to this process. Several changes to operational protocols over the past year resulted in significant improvements in the quality and throughput of potato plantlets from this laboratory. These plantlets are used by FPDA to produce minitubers and the subsequent field-grown generations of Certified Seed Potatoes in PNG.

CP/2004/071: Reducing pest and disease impact on yield in selected PNG sweet potato production systems

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Mr Eric Coleman Phone: 07 4936 0211 Fax: 07 4936 0345 Email: eric.coleman@dpi.qld.gov.au
Collaborating Institutions	Queensland University of Technology, Australia National Agricultural Research Institute, Papua New Guinea National Agriculture Quarantine and Inspection Authority, Papua New Guinea Fresh Produce Development Agency, Papua New Guinea International Potato Center, Peru
Project Budget	\$905,775
Project Duration	01/04/2006 to 31/03/2010
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

In Papua New Guinea, sweet potato is the mainstay of the country's food security. Current production is 2.9 million tonnes per annum, worth an estimated \$A700 million, and accounts for 63 per cent of the dietary energy of the population. Notwithstanding the dominance of the crop, both to the subsistence economy and increasingly as a cash crop on domestic markets, it has some production problems.

Apart from climatic factors such as El Niño events, which cause major but temporary falls in production, farmers and scientists have noted a gradual decline in yields and the quality of tubers, the cause of which is not always obvious. This decline has implications for food security and needs investigation. A visit to PNG to assess the situation in March 2005 identified a number of pests and diseases, along with crop physiology issues, that may be involved in the decline. The main aim of this project is to identify and address these problems.

The project is taking part in a constraints analysis being undertaken by ACIAR (SMCN 2005/045) into sweet potato production in Papua New Guinea. It is also cognisant of other ongoing ACIAR projects - ASEM/2003/010 on sweet potato yield improvement through varietal evaluation and another contract project (ASEM 2005/044) on marketing of sweet potato in Papua New Guinea. There is already a strong linkage with the pipeline PNG soil fertility project, including participation in that project's scoping study.

The project is building on results of past ACIAR-supported projects on sweet potatoes in PNG and other countries of the South Pacific, carried out by the Southeast Asian Program for Potato Research and Development (SAPPRAD) in association with the International Potato Center (CIP). The work complements existing sweet potato research of UNITECH (Farmer participatory approach to selection of high- yielding sweet potato, *Ipomoea batatas*, varieties in Morobe) funded under the AusAID Agriculture Innovations Grant Facility (AIGF).

This project also links with a new CIP project, *Improving informal seed systems for sustainable sweet potato production under resource-poor farming conditions in Indonesia and the Pacific*, which ACIAR has accepted for funding.

Project Progress

Year 1 (01/04/2006–31/03/2007)

The first meeting of the Project partners; Queensland Department of Primary Industries and Fisheries (QDPI&F), National Agricultural Research Institute (NARI) and Fresh Produce Development Agency (FPDA), was held at Madang on 26–27 June 2006. The objective of the meeting was to plan the activities of the first year of the project and to review briefly the focus of the second year.

The key activities identified for the first year of the project were to:

- review and analyse previous literature
- assemble the most relevant germplasm
- perform preliminary identification of virus and virus-like diseases
- introduce PT material from Australia or other sources
- initiate sweet potato weevil assessment sites
- identify and develop extension/information networks.

The time and venue of this meeting were chosen so that participants could attend a following ACIAR-sponsored Sweet potato Workshop (June 28–29). Following the workshop visits were made to sweet potato farmer evaluation sites (conducted by World Vision), also local markets and supermarkets in Madang and Port Moresby to evaluate commercial varieties on sale.

To assist with the dissemination of information (between project members), *KauKauNet* was set up by team member Grahame Jackson. This is a free, easy-to-use group service at Yahoo Groups, enabling team members to easily send and receive group messages.

Two aphid proof tunnelhouses (igloos) manufactured by Fernland Agencies Nambour Queensland Australia were forwarded to PNG for establishment at Aiyura. One igloo is to be used for propagation of virus free sweet potato cuttings and the other for virus indexing.

Sixteen virus-indexed sweet potato accessions were sourced from the Secretariat of the Pacific Community (SPC), Suva, Fiji for evaluation in the project. The germplasm was originally acquired by the SPC from Papua New Guinea through the EU-funded Pacific Regional Agricultural Programme (Project 4: Selection, Trial and Dissemination of Sweet Potato Cultivars). The import permit was generated by NARI and the accessions are now located in the tissue culture facilities at Aiyura.

Ten PNG accessions were also obtained from the University of Queensland sweet potato collection and are now in the collection at Bundaberg. These accessions are undergoing virus indexing for evaluation as possible material for dissemination in PNG.

In consultation with the National Agricultural Quarantine and Inspection Authority (NAQIA) in PNG import permits were raised for *Ipomoea setosa* (indicator plant used in virus indexing) and *Ipomoea batatas* (sweet potato). NAQIA Officer David Tenakanai visited Queensland to inspect DPI&F's virus indexing program including quarantine facilities. On returning to PNG David oversaw the importation of *Ipomoea setosa* seed and the two main Australian sweet potato varieties (Beauregard and Northern Star) as tissue-cultured plantlets. Beauregard is a CIP mega-clone.

After some initial difficulty in finding the right contacts two NCM-ELISA Kits for virus detection were purchased from CIP in Peru for use in PNG. A further three kits have been ordered for use in Australia.

Two literature reviews were completed. The first focused on scientific literature about sweet potato weevil, with particular emphasis on literature from Papua New Guinea, Australia and recent advances in non-chemical control/management strategies. The second was on sweet potato pests and diseases, focusing on the most important diseases that affect sweet potato in PNG, including diseases caused by fungi, viruses, phytoplasma and nematodes.

A third review on germplasm in PNG is in the final stage of completion. This focused on highland varieties and, due to the large number of varieties and the lack of detailed evaluations available, the Australian project

team needs more consultation with PNG counterparts to finalise the write-up.

A second trip to PNG by project officer Mike Hughes occurred in November. The objective of the trip was to identify and collect sweet potato varieties for project evaluation. Eleven varieties were collected. Varieties have been planted at Aiyura and are also at Quarantine in Brisbane, Australia waiting virus indexing.

These varieties will also provide an initial survey sample of virus diseases and will help the project team to develop a scope for in-field pest and disease survey work. Other project activities conducted during the trip were the initial planning for 2007 sweet potato weevil trials and identification of possible partners for developing extension/information networks. Networks are to be developed for the Participatory Technical Development (PTD) phase of the project. Further to development of the PTD approach, meetings were held with a Nambour-based DPI&F officer involved in similar approaches in the Philippines.

Segundo Fuentes, a virologist from CIP, visited Queensland as part of the project outlining CIP's current involvement in virus R&D in sweet potatoes. Segundo provided the project team with information on using tissue-cultured plants in heat treatment for virus removal, a process the project team is to research for application to PNG (and Australia). Segundo then flew to PNG for discussion with the project's NARI collaborators. Segundo provided the teams with the latest information on virus detection methods and new information on virus elimination, in particular the use of in-vitro thermotherapy.

HORT/2005/134: The use of pathogen-tested planting materials to improve sustainable sweet potato production in Solomon Islands and Papua New Guinea

Multilateral

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	International Potato Center, East and Southeast Asia and the Pacific Regional Office, Indonesia
Project Leader	Dr Fernando Ezeta Phone: 62 251 317951 Fax: 62 251 316264 Email: f.ezeta@cgiar.org
Collaborating Institutions	Queensland Department of Primary Industries and Fisheries, Australia National Agricultural Research Institute, Papua New Guinea Department of Agriculture and Livestock, Solomon Islands Kastom Gaden Association, Solomon Islands
Project Budget	\$849,742
Project Duration	01/09/2006 to 31/08/2010
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

In Papua New Guinea and Solomon Islands yield decline has been recorded in sweet potato varieties over time. Introducing and adapting technologies that produce consistently high-yielding and nutritious crops of sweet potato can help to satisfy household consumption, improve human nutrition and supply domestic markets.

A key to achieving high productivity and nutritious tuberous roots of sweet potato is the use of healthy cuttings (termed 'seed') and cultural practices which promote plant vigour and reduced pests and diseases. However, as a prerequisite, there is need to understand the seed supply system. How do farmers retain planting material from crop to crop or obtain new cultivars as those presently grown decline.

The project will investigate these aspects in both countries. Pathogen tested material will be introduced and tested using extension practices perfected by the International Potato Center (CIP) in Asian countries. Project work will involve national research and extension institutions, non-government organisations, community-based organisations and lead farmers.

The majority of the project's activities will be implemented in the Solomon Islands (SI) for two reasons: first, recent reviews have shown an urgent need to deal with falling crop yields in areas of high cropping intensity resulting from

rapid population increase; second, some work of a similar nature focusing on the highlands has commenced in Papua New Guinea (PNG) during ACIAR project CP/2004/071, therefore this project will focus mainly on the PNG lowlands.

Project objectives are to describe and evaluate sweet potato seed supply systems in Papua New Guinea and Solomon Islands, to introduce and evaluate improved varieties, and to introduce, refine and disseminate technologies for improved supply systems of sweet potato seed for smallholders practising low-input agriculture.

Project Progress

Year 1 (01/09/2006–31/08/2007)

The project started by conducting a project-launching workshop in Honiara, SI, from February 13 to 15 2007, bringing together representatives of the main partner institutions from Solomon Islands, Papua New Guinea and Australia, and from CIP. The program of the workshop included an update on installed regional institutional capacity, a review of project activities for the first year, assignment of institutional responsibilities and a chronogram for execution.

Participants gave presentations as background information, sharing previous knowledge and committing efforts to those

areas better suited to their institutional capacities. Special attention was given to discuss the main factors limiting sweet potato production in Solomon Islands.

The outcome of the workshop was an agreed work plan for the first year. Soon after the workshop the project contracted the services of a local recruiting company to launch the search for a local coordinator for the project in Solomon Islands. A shortlist of two candidates was identified and reviewed by a selection committee of CIP in consultation with the two main local partner institutions in SI.

The successful candidate Mr. Lawrence Lionel Atu was appointed Local Project Coordinator in the Solomon Islands on July 25. He is responsible for technical and administrative matters of the project in the SI and will facilitate collaboration between the Department of Agriculture and Livestock (DAL), Kastom Gaden Association (KGA), and farmers.

A local CIP Office was established in Honiara on July 16 in collaboration with the Ministry of Agriculture and Livestock (MAL) and Kastom Gaden Association (KGA). Development of the baseline questionnaire was urgently required to describe the seed supply system in Solomon Islands. The draft was prepared based on information and recommendations recorded during the launching workshop, review of previous survey documents as well as the initial baseline survey developed by CIP for a survey undertaken in East Africa.

The draft was shared with DAL, KGA, CIP-Lima and UPWARD for comments and inputs in order to adapt the questionnaire to local conditions and to refine questions and better focusing. Field testing of the questionnaire was carried out on July 23 with farmers at St Martin and Binu villages, Guadalcanal Plains..

Introduction of sweet potato varieties to Australia for clean-up has started by sending 1717 sweet potato breeding lines to QDPI&F. Once this material is 'cleaned' it will be eventually introduced in Solomon Islands for local trials. The clones will be exposed to thermotherapy to produce pathogen-tested (PT) clones that later will be multiplied at the Regional Germplasm Centre of the SPC for later distribution. CIP Peru has sent to QDPI&F two sets of sweet potato clones. One set includes orange-fleshed clones and varieties rich in β -carotene.

The other set is composed by 21 clones (mega-clones) with best performance and wide adaptation. These clones were sent to QDPI&F at the request of Dr. Graham Lyons who coordinates an ACIAR-funded Harvest Plus project. Sweet potato clones from Solomon Islands will be collected during the survey at the end of September. Ten varieties will be selected from two survey sites (Guadalcanal Plains and Weather Coast). Varieties chosen for PT at QDPI&F will those which, in terms of taste, earliness and yield, are best in the opinion of the farmers.

HORT/2006/106: Screening and field trials of high-carotenoid sweet potatoes in Solomon Islands and Papua New Guinea to improve human vitamin A status

Bilateral

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	University of Adelaide, School of Agriculture, Food and Wine, Australia
Project Leader	Dr Graham Lyons Phone: 08 8303 6533 Fax: 08 8303 7109 Email: graham.lyons@adelaide.edu.au
Collaborating Institutions	International Potato Center, Indonesia Kastom Gaden Association, Solomon Islands National Agricultural Research Institute, Papua New Guinea Department of Agriculture and Livestock, Solomon Islands
Project Budget	\$131,000
Project Duration	01/02/2007 to 31/01/2010
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Many people in Solomon Islands and Papua New Guinea (PNG) do not receive enough dietary vitamin A, which is vital in boosting immunity to disease. Vitamin A supplementation of infants in PNG reduced the effects of malaria, but it would be preferable to be receiving enough vitamin A through the diet.

The orange sweet potato (OSP) is a nutritionally-enhanced staple containing among the highest concentrations of beta-carotene (the major pro-vitamin A carotenoid) of any food—as little as 100 grams per day can prevent vitamin A deficiency.

This activity is surveying promising coloured Solomon Island and PNG sweet potato cultivars for carotenoids, in particular beta-carotene. It is also examining the cultural and social dimensions of sweet potato in the diets in Solomon Islands and PNG, to determine how to promote OSP as a healthy dietary component and to increase its consumption. As well it will introduce improved OSP cultivars and compare them with the highest-carotenoid local cultivars.

Project Progress

First progress report due in 2008.

SMCN/2003/010: Farmer evaluation and multiplication of sweet potato varieties on the North Coast of PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	World Vision Australia, Australia
Project Leader	Mr Jonathon Treagust Phone: 03-9287 2509 Fax: 03 92872377 Email: jonathan.treagust@worldvision.com.au
Collaborating Institutions	Australian National University, Australia World Vision Trust Pacific Division, Papua New Guinea National Agricultural Research Institute, Papua New Guinea
Project Budget	\$808,375
Project Duration	01/04/2004 to 30/11/2008 (Project extended from 01/08/2007 to 30/11/2008)
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

Papua New Guinea's (PNG) population is growing at a rapid rate, resulting in increasing land intensification, particularly for agriculture. As a result more productive crops are being planted, with sweet potato leading the way. The crop is now the most important for more than 60 per cent of the population, providing almost a third of total calories consumed.

The possibility of future drought and increasing pressure on land use make the delivery of more productive lines important. In addition the wide range of agro-ecological zones in which sweet potato is grown makes it highly likely there are varieties better suited to localised conditions and offering yield boosts.

NARI has collected and trialed many crops and varieties that are likely to benefit farmers who face current yield constraints. A lack of clear line authority from national to provincial agricultural agencies has resulted in a sporadic extension of improved varieties.

On PNG's north coast many communities stand to benefit from accessing improved varieties with more reliable output. Increased yields are likely to result in increased income and provide a reserve against drought and other disasters that often strike these areas. The main objective of this project is to evaluate sweet potato varieties and disseminate appropriate choices to the rural farming sector along the north coast of PNG.

Project Progress

Year 3 (01/04/2006–31/03/2007)

Project progress to-date:

Harvest of Technician-Controlled-on-Farm Trial two (TCOFT 2), April–September year 2006 period:

- All data from TCOFT inputted and analysed. Results corresponded closely to TCOFT 1
- From 14 varieties, four (plus two Farmer Controls) were high yielding, with SI85 still rating the best
- Harvesting also occurred on the additional Sequential Trial
- Participatory Technology Development (PTD) field days were held at each of the six sites to prepare farmers for second stage and involve them in criteria selection
- Waput Women's group also took part in two PTDs showing other women how to prepare sweet potato in different ways
- A Sweet Potato Recipe Leaflet was also distributed at the six PTDs.

ACTIVE PROJECTS

Planting of FCOFT 1 (delayed until July–October 2006, because of farmers' reluctance to plant during unusually dry weather):

- 20 trials were planted in each of the six locations (120 trials in total), but data from only 60 farmer trials were collected
- Approximately 13 trials out of 120 were destroyed by pigs and a further three were infested by sweet potato weevils
- Data have been entered but not analysed for FCOFT 1.

FCOFT 2 was planted during January–March 2007 period:

- Plant growth has been vigorous due to the high rainfall during this period, resulting in earlier tuberisation and thus increased theft
- Long Island was added to the trials for the first time during FCOFT 2
- All varieties planted except for DOY2 and L46 have shown resistance/tolerance to waterlogging.

Additional events:

- ACIAR International Sweet Potato Conference facilitated by the Project Manager in mid-June 2006
- Four Care Centres house 9,923 displaced people from the Manam Volcanic eruption, and World Vision help coordinate each site. Staff from the project, along with staff from the Provincial Department of Agriculture, Livestock and Fisheries (DALF) were involved in a week-long survey of the status of food supply in these centres
- The Sweet Potato project has distributed up to 51,000 pieces of planting material to the Manam Care Centres, and helped to establish multiplication plots
- The Sweet Potato project also links in with the Livelihood Support Project that World Vision runs in each Care Centre
- Mr. David Brown, formerly of Queensland DPI&F, joined the project as a full-time Agricultural Advisor. He will assist with the writing of the final report and the compilation of project data

- The project initiated the World Vision stall for the National Disability Day. The field staff mounted posters of work done in different districts, conducted cooking demonstrations and displayed vines and tubers of different sweet potato varieties.

SMCN/2004/067: Soil fertility management in the PNG highlands for sweet potato based cropping systems

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Queensland, School of Land and Food Sciences, Australia
Project Leader	Dr Neal Menzies Phone: 07 3365 2059 Fax: 07 3365 2968 Email: n.menzies@uq.edu.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Queensland Department of Primary Industries and Fisheries, Australia Lutheran Development Service, Papua New Guinea
Project Budget	\$1,166,280
Project Duration	01/04/2007 to 31/03/2012
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

Population growth in the PNG Highlands is around 2–3%, amongst the world's fastest-growing areas. Despite these high growth rates the area under agricultural production has remained relatively stable, with concomitant intensification of land use. This is placing unprecedented pressure on the land resource and on the long-term productivity of sweet potatoes, the main staple.

A scoping study to analyse soil constraints in sweet potato-based cropping systems and a survey of Highland farmers in 2005–06 (ACIAR Project SMCN/2005/043) confirmed that farmers are concerned and well aware of yield decline. They relate it to deteriorating soil fertility and the use of old sweet potato varieties. A comparison of yields from gardens which had been fallowed and were brought into production recently ('new' gardens) with those from gardens that were due to go back under fallow ('old' gardens) revealed a 50% yield decline in tuber yield.

The results of the study confirmed that there is scope to improve productivity of sweet potato-based systems in the Highlands by addressing soil fertility as a major factor in yield decline. This is underpinned by clear farmer awareness of the problem and interest in becoming engaged. The study also confirmed that several indigenous soil management options already operating in the PNG Highlands could be capitalised on and, if necessary, modified to enable permanent cropping.

The objectives for this project are:

- to assess and quantify soil and water processes in Highland soils
- to develop and implement improved nutrient and water management options for sweet potato-based cropping systems
- to enhance soil research capacity in PNG.

Project Progress

First progress report due in 2008.

CP/2002/013: Biology, damage levels and control of red-banded mango caterpillar in Papua New Guinea and Australia

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Centre for Tropical Agriculture, Australia
Project Leader	Mr Bruno Pinese Phone: 07 40484666, 07 40484600 Fax: 07 40923593 Email: bruno.pinese@dpi.qld.gov.au http://www.dpi.qld.gov.au
Collaborating Institutions	Department of Agriculture, Fisheries and Forestry, Australia National Agricultural Research Institute, Papua New Guinea National Agriculture Quarantine and Inspection Authority, Papua New Guinea
Project Budget	\$357,291
Project Duration	01/07/2003 to 30/06/2007 (Project extended from 01/07/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The Red Banded Mango Caterpillar (RBMC) is widespread throughout Southeast Asia, although its abundance in many areas is very low. Papua New Guinea has RBMC present, as do a few islands in the Torres Strait, separating PNG from Australia. Mainland Australia was free of the caterpillar until recently, when small numbers were detected in feral mango trees on the tip of the Cape York Peninsula.

Little is known about the biology of the RBMC, despite the significant losses it can cause. In Indonesia and PNG losses of between 30 and 40 per cent of mangoes on infected trees are common, with losses as high as 80 per cent in some places. Pest management is dependent on knowledge of the lifecycle, strengths, weaknesses and behaviour patterns, as well as natural enemies of the RBMC. Management to eradicate pests without this knowledge may result in adverse consequences for other insects, fruit quality and productivity.

The caterpillars feed on mangoes at all stages of fruit development, with successive generations burrowing closer to the seed. Improved knowledge of this lifecycle will help determine potential controls, both to eradicate and prevent pest losses. The project is studying the biology of the RBMC as a means of identifying methods to better manage the pest.

Project outcomes

This three-year project had very specific activities directed mainly at elucidating the biology and ecology of the red banded mango caterpillar. Although progress was made, many components of the insect's basic biology remain unknown or in doubt. It is clear that in parts of PNG where RBMC is established, it causes significant loss of fruit and that control by conventional chemicals will be difficult and likely irrelevant to local communities.

The project succeeded in developing a potential pheromone lure that will be of long-term benefit to Australia and PNG for pest monitoring purposes, and has potential use in a 'lure-and-kill' strategy.

ASEM/2001/016: Microbial contaminants associated with sago processing and storage in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	James Cook University, Australia
Project Leader	Dr Jeffrey Warner Phone: 07 4781 6375 Email: jeffrey.warner@jcu.edu.au
Collaborating Institutions	Queensland Department of Primary Industries and Fisheries, Animal Research Institute, Australia University of Technology, Department of Applied Sciences, Papua New Guinea University of Papua New Guinea, School of Humanities and Social Sciences, Papua New Guinea
Project Budget	\$549,858
Project Duration	01/07/2002 to 31/12/2007 (Project extended from 01/01/2005 to 31/12/2007)
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Sago harvesting and consumption form an important part of the staple diet in selected areas of Papua New Guinea (PNG). However, this resource (in excess of 1 million hectares) is under-utilised. There is an estimated market for sago starch in PNG in excess of 12,000 tonnes (of which some is imported), and part of the international trade in starch, (15,000–20,000 into Australia alone) at \$A150–200 per tonne could be filled by PNG sago. However the ability to satisfy these markets with high-quality starch, essentially free of mycotoxins and food-borne pathogens, is not assured.

Contaminant problems relate to the presence of mycotoxins in the starch. The mycotoxins may cause sago haemolytic disease, which is prevalent in the main sago-growing areas to the south of the country, however, its cause has never been resolved. Contamination of food with pathogenic bacteria and viruses is likely to be of a widespread nature, since the incidence of diarrhoeal disease is extensive and is caused by some of the self-same bacterial agents associated with contamination. This has been shown in experimental sampling from selected market sites. The extent and seriousness of sago contamination is not understood, nor indeed can it, until a more extensive investigation is mounted.

Both contamination problems (fungal and bacterial) and the development of suitable solutions to them are of equal importance to the

development of PNG sago as a village food and as a trade commodity. This project is determining the causes and extent of health risks to consumers caused by contamination in village-produced sago in Papua New Guinea to identify options for reducing those risks and improving marketability of the processed sago.

Project Progress

Year 4 (01/07/2005–30/06/2006)

Work to determine the significance and characterisation of haemolytic compounds derived from fungi isolated from sago starch has commenced. To date, the techniques to fractionate crude haemolytic extracts from *Penicillium steckii* have resulted in isolated bands of haemolytic activity which are awaiting further characterisation with High Performance Liquid Chromatography. Techniques based on these methods have been prepared from other fungi with haemolytic properties.

Techniques to determine the activity of these haemolytic fractions on red cell membranes have been optimised and await to be utilised with purified compounds. A Hazard Analysis and Critical Control Point (HACCP) study which guides the safe preparation and storage of sago starch in PNG has been completed and initial plans for the publication of these points for village-based use is under way.

ASEM/2002/014: Improving productivity and the participation of youth and women in the Papua New Guinea cocoa, coconut and oil palm industries

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Curtin University of Technology, Australia
Project Leader	Dr George Curry Phone: 08 9266 3310 Email: g.curry@curtin.edu.au
Collaborating Institutions	Cocoa and Coconut Research Institute, Papua New Guinea Oil Palm Research Association, Papua New Guinea PNG Cocoa & Coconut Extension Agency, Papua New Guinea
Project Budget	\$647,736
Project Duration	01/07/2003 to 31/12/2007 (Project extended from 01/07/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

A recent ACIAR-funded project promoted interventions in the smallholder oil palm sector of Papua New Guinea (PNG), including the increased participation of women in the industry through the 'lus frut mama' card scheme.

These interventions led to significant increases in smallholder productivity, and this project aims to replicate such achievements in the PNG smallholder cocoa and coconut sectors. Researchers are conducting an in-depth evaluation of a promising new payment system (also arising from the earlier ACIAR project) for oil palm smallholders at Hoskins, West New Britain and seek to further adapt it for other smallholder oil palm regions and for the smallholder cocoa sector in PNG.

The project is designed to promote the sharing of knowledge and expertise between the key smallholder extension agencies and research organisations in the three industries.

Project Progress

Year 3 (01/07/2005–30/06/2006)

During 2005 and 2006 it was intended to adapt and trial the new payment initiative amongst cocoa growers in East New Britain (ENB) and further refine and test the payment method amongst oil palm smallholders at Bialla, WNB. In late 2005, work commenced amongst cocoa growers near Tokiala Plantation in ENB, in an initiative supported by New Guinea Island Produce (NGIP) (Tokiala Plantation is owned by NGIP).

A baseline survey involving a demographic and livelihood survey was undertaken amongst smallholder cocoa growers who were to participate in a trial involving the private sector (NGIP) in the delivery of extension services including the testing of a new payment mechanism to raise smallholder productivity. However, the outbreak in ENB of Cocoa Pod Borer (CPB) in early 2006 meant that the work on cocoa was suspended for the rest of the year as CCI focused all its efforts and resources on the eradication of this major pest. The work in cocoa will recommence in early 2007.

With the delay in the cocoa research program arising from the CPB outbreak, the new payment trial amongst oil palm smallholders at Bialla was brought forward. The Bialla trial builds on the Hoskins trial and includes: village oil palm (VOP) growers; blocks managed by 'caretakers'; labour-short blocks of elderly growers in the older land settlement subdivisions where replanting has been delayed; and labour-short blocks occupied by young families.

The earlier Mobile Card trial amongst Hoskins VOP growers revealed that some blockholders were reluctant to use the same contract labourer for an extended period to prevent the labourer building up 'ownership' rights in the block. To circumvent this problem, the Bialla trial is employing labouring groups on VOP blocks — youth, church and sports groups — because such contract groups do not undermine the tenure rights of the blockholder.

In February 2006 the Mobile Card trial began with the recruitment of two extension officers and the implementation of an awareness program amongst growers. By May 2006 Hargy Oil Palms Ltd had incorporated the percentage split between the blockholder and the Mobile Card worker into their smallholder payment system. In June 2006, 12 blocks were participating in the trial and this number will rise to 40 by the end of 2006.

A preliminary assessment of these 12 blocks indicate that production and block management are steadily improving, and the new payment system introduced into the company payment system is operating successfully. The results of a visit to the Bialla trial by a CCI research collaborator to briefly assess the trial will be used in the design of the Mobile Card trial in the cocoa smallholder sector.

During the year progress was also made on examining strategies to improve the capacity of research and extension services in the cocoa sector. Two public seminars were held at CCI and with the Cocoa Board in ENB outlining the results of the smallholder socio-economic studies and proposed recommendations to improve research and extension services. Feedback from these seminars is being incorporated into the draft smallholder cocoa report to be completed in January, 2007.

Also, fruitful discussions with the private sector have continued to assist in developing and evaluating new extension models involving partnerships between smallholder growers/customary landowners and the private sector. For example, in the cocoa sector, NGIP is servicing smallholders in ENB by providing planting materials, tools and extension advice. Thus, rather than limiting its activities to buying cocoa, as has been the case in the past, the company is now becoming more involved in supporting smallholders to raise productivity and increase or rehabilitate the area under cocoa production. This has the potential to substantially increase smallholder incomes, particularly in more remote areas where extension and support services are virtually absent.

In 2006 the research team visited WNB to assess similar models currently being established for cocoa growers by Kimbe Bay Shipping Agency (KBSA). These new forms of extension tend to be self-sustaining (largely self-funding), and they are raising smallholder productivity and improving the quality of product for international markets. As well as the social benefits arising from higher smallholder incomes associated with increased productivity, some of these new initiatives are also generating additional social benefits such as improved participation rates of women in export cash cropping and increased economic opportunities for rural youth.

Finally, the research team is working with the Cocoa Coconut Institute of PNG and the PNG Oil Palm Research Association to run a one-day workshop in Port Moresby in March 2007 to 'showcase' successful initiatives in agricultural extension involving partnerships between smallholders and the private sector in PNG's main export tree crops. The aim of the workshop is to identify key principles that have contributed to the success of each new extension initiative, and to incorporate these into a set of guidelines to assist smallholders and industry organisations develop partnerships for the delivery of effective extension in a range of tree-crop export industries.

ASEM/2003/015: Enhancing PNG smallholder cocoa production through greater adoption of disease control practices

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Sydney, Faculty of Agriculture, Food and Natural Resources, Australia
Project Leader	Professor David Guest Phone: 02 9351 2946 Email: d.guest@usyd.edu.au
Collaborating Institutions	Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea MasterFoods Australia New Zealand, Australia Papua New Guinea University of Technology, Papua New Guinea
Project Budget	\$549,920
Project Duration	01/01/2005 to 31/12/2007
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Papua New Guinea's (PNG) cocoa sector supplies two per cent of the world market. Most of the total PNG crop comes from around 70,000 smallholders. The cocoa industry is worth an estimated K168 million (\$A87 million) a year based on 42,000 tonnes production. Smallholders usually grow cocoa as a supplementary income source, with few inputs and low costs reducing the impacts of market price fluctuations.

One reason for the low input and production costs is the lack of applicability of cocoa management recommendations. These recommendations date back to when the plantation industry was the dominant producer. When this industry sector was broken up smallholders emerged to take the place of plantation producers. The relevance of recommendations for management, including those for disease control, declined along with the plantation sector.

Productivity levels endured a similar and associated decline. One of the major causes was and remains diseases. Pod rot and canker caused by *Phytophthora palmivora*, vascular die back streak and pink disease are the main inhibitors to productivity. New technologies, management approaches and resistant breeds against diseases are available but not widely adopted, or even known, among smallholders. Improving adoption of these approaches would significantly increase productivity and with it the income on offer to smallholders.

The objectives of this project are to sustainably increase the profitability of smallholder cocoa production in PNG through the development of effective and affordable strategies in partnership with farmers, and to develop effective management options for the major disease threats to production, by:

- documenting disease losses and smallholder knowledge, skills and attitudes to disease management at selected district sites
- fostering evaluation and adoption of a range of integrated disease management strategies in partnership with smallholders
- enhancing research and development expertise and strengthening industry linkages.

Project Progress

Year 2 (01/01/2006–31/12/2006)

This project facilitates farmer adoption of new management strategies among cocoa smallholder farmers through on-farm participatory action research (PAR) and village-based extension. In March 2006, the destructive Cocoa Pod Borer (CPB; *Conopomorpha crameriella*) was found in East New Britain Province (ENBP). A national state of emergency was declared by the PNG government resulting in a large-scale monitoring and eradication program.

Dr Konam was made Chairman and Technical Leader of the CPB eradication program, and all Plant Pathology staff involved in the project were seconded to the operation. Despite the significant disruption caused by the CPB to this project, project activities and outcomes continued where possible.

The baseline farmer surveys in ENBP and Madang Province (MP) have been completed. The surveys in North Solomons Province (NSP) will be finalised by April 2007. They were delayed as a result of the CPB incursion. Farmers have shown significant interest in the new management options. Initial indications suggest that many farmers are adopting the new options, particularly when they see the impact of the management changes. Farmers are learning to keep records of the yield and disease levels in their cocoa blocks. Through the process of farmer training, project staff are also learning more effective methods of surveying and extending the management options to farmers.

Adoption of management options is being promoted using an on-farm PAR-based approach. Integrated Pest and Disease Management (IPDM) PAR demonstration plots have been established at Kareeba, Bitagalip and Tokiala in ENBP. Farmers from neighbouring villages, not directly involved in the project, are implementing the new options in their own plots, with no direct input from CCI project staff. The transfer of information has been through farmer-farmer communication, particularly where positive outcomes in yield and disease management have been demonstrated. In Madang Province, IPDM PAR plots have been set up at Saidor, SRS-Madang and on Kar Kar Island. Monitoring of these sites for disease incidence and yield will begin in March 2007.

IPDM demonstration plots in NSP are planned for Buka, Arawa and Tinputz. Mr Paul N'nelau of CCI-Buka travelled to ENB in March 2006 to be trained in conducting baseline surveys and in implementing the IPDM options in cocoa gardens. Staff from CCI-Kerevat will travel to NSP March 2007 to complete the baseline surveys, train extension officers and to establish the PAR trial sites. In July 2006, a field day was held in Garus near Madang to demonstrate the IPDM options to cocoa growers. Farmers were led through the IPDM options and the benefits of these options, disease management and

improved yields were discussed. Industry service providers displayed additional information. Approximately 400–500 farmers participated, indicating the high level of interest raised by the new management options.

A training course for extension staff at CCI-Kerevat, postponed as a result of CPB, is scheduled to resume in April 2007. A total of 132 farmers and six extension staff have participated in a training school in ENBP to promote the new options. In MP, more than the expected number of model farmers has been trained. These farmers train and foster the adoption of improvements in other cocoa gardens in their village.

Mini-field days, or 'awareness days', have been held in MP and ENBP to extend the IPDM options. In MP a labourer is being trained as 'village cocoa protectionist' to coordinate field days, baseline surveys and IPDM demonstration plots under supervision from Yak Namaliu (cocoa pathologist in Madang). A CCI-ISD extension officer based on Kar Kar Island is being trained in IPDM technologies through PAR. In MP, PAR 'outreach' groups have been established to implement IPDM options outside the direct control of the project. A training manual outlining IPDM options has been produced and distributed to extension staff and farmers. The manual has been given to colleagues in other cocoa-growing countries including Vietnam and Indonesia.

To promote training of future cocoa industry extension personnel and adoption of new technologies in the cocoa industry, UniTech-Lae is revising its Perennial Crop Production curriculum. Technical notes and information on cocoa pathology and entomology were provided by CCI Plant Pathology staff. UniTech has established the four IPDM options to train fourth year undergraduate students. All graduates will be experienced in all levels of the IPDM options presented to farmers. The discovery of CPB presented the opportunity to test the IPDM options developed in this project against CPB in the coming years. In November 2006 a workshop organised by CCI-PNG was held to discuss current and future management recommendations for CPB in PNG.

ASEM/2004/017: Assessment and improvement of quality management during postharvest processing and storage of coffee in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of New South Wales, Department of Food Science and Technology, Australia
Project Leader	Dr Robert Driscoll Phone: 02 93854355 Fax: 02 93855937 Email: r.driscoll@unsw.edu.au
Collaborating Institutions	PNG Coffee Industry Corporation, Papua New Guinea AT Projects, Papua New Guinea
Project Budget	\$760,812
Project Duration	01/01/2006 to 30/06/2009
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

The PNG coffee industry supports up to 400,000 families and earns K300 million per annum, but the consistency and reliability of coffee quality has declined with the move to the low-input management of the smallholder industry (>85%, the remaining plantation and 'block' production has received higher prices). Despite this general decline, premium PNG coffee retains a good reputation amongst customers and there is good scope to build demand for PNG coffee by improving marketing and quality.

PNG highlands coffee is of the *arabica* species, and the genotype x environment (G x E) potential is ideal for good quality coffee. However, critical postharvest steps – from harvest, through wet processing, drying, grading, storage and transport – affect coffee quality and grade/sales potential, while further steps (roasting, grinding etc.) affect end-market opportunities for the coffee quality/grade received by the roaster.

Farmers can sell ripe coffee cherries, semi-processed (parchment stage) or dehulled (green) beans to processors or exporters, with higher price/return potential for growers who process to the parchment or green bean stages. Key elements of the quality deterioration that can result from grower processing are: mouldiness and the development of off-flavours due to inadequate drying and storage, and poor grading (product variability, mixed ripe and green cherries, inclusion of small or defective beans or foreign matter). Income to smallholders is 10–25 per cent lower than it could be if

product attributes and quality were consistently acceptable.

In the 1990s, the PNG Coffee Industry Corporation (CIC) undertook research and began to implement quality management strategies which began to reverse the quality deterioration experienced in the 1980s. There is continuing interest amongst farmers to address the technical and economic factors that underpin the quality problems in processing (particularly wet processing and drying), storage and marketing, and to improve produce uniformity.

The project complements ASEM/2004/042 on improvement of coffee marketing, because it will provide options for processing, drying and storage that allow growers to reliably supply higher quality coffee where a marketing system is in place to facilitate payment for higher quality characteristics. The strong links with ASEM/2004/042 will lead to joint surveys and information sharing.

Project objectives are to:

- assess postharvest system constraints to smallholder management of coffee quality and product consistency
- develop and test solutions to system deficiencies, with particular attention to improvement of drying and storage
- devise and implement strategies for the adoption of system improvements.

Project Progress

Year 1 (01/01/2006–31/12/2006)

Key activities outlined in the project proposal have been carried out as follows.

Assess postharvest system constraints to smallholder management of coffee quality and product consistency.

The first year of the project implementation has been devoted to the acquisition of baseline data from a number of available sources. First of all, the project teams needed to get acquainted with the current production techniques used in the highlands of Papua New Guinea, especially in the Eastern Highlands Province, where the Coffee Industry Corporation (CIC) and its research arm, Research and Growers Services Division, are located.

In order to acquire the relevant information the project teams conducted field surveys using questionnaires designed jointly by the UNSW and CIC teams. The questionnaires covered a range of topics such as harvesting process, pulping, fermenting, washing coffee beans, drying, handling coffee waste, labour involvement, production figures by household, coffee transportation, form in which the coffee crop is sold (cherry, parchment, green beans), timing of sale, coffee buyers, attitude towards adoption of new technologies (drying, wet processing), coffee quality assessment from the perspective of roasters and exporters as well as a range of questions related to the socio-economic situation and educational level of the respondent.

The surveys have been conducted mostly by the CIC team where their extension officers have a good local knowledge of coffee farming community.

Moreover, the project team liaised with the other two other ACIAR funded projects, ASEM/2004/047 (Coffee Green Scale) and ASEM/2004/042 (Collaborative Marketing). The research teams of these projects have also conducted surveys about specific aspects of the coffee production and their findings provide a useful contribution in the assessment of the existing smallholder management of coffee quality. Some inputs have also been obtained from the AT projects at Goroka that have recently started collaborating with CIC team. The surveys are on-going as well as the data analysis.

Develop and test solutions to system deficiencies, with particular attention to improvement of drying and storage

The project teams are currently working on the evaluation of the criteria for coffee quality assessment in PNG. This work has been mostly done at the UNSW where adequate laboratory facilities are available. Samples of green coffee have been imported from PNG and also from northern NSW. While drying and storage experiments were conducted with samples from northern NSW, the work on quality, especially on the aroma components was done on samples from both origins.

The evaluation of the quality of coffee was based on the results of instrumental as well as sensory analysis. More work on the quality of PNG coffee will be done once the laboratory of Research and Growers Services Division in Aiyura near Ukarumpa has been constructed and equipped. The construction work is progressing.

The UNSW project team will advice on the use of laboratory equipment once the latter has been procured. An ecologic coffee demucilager for wet process, model UCBE 500 M, has been ordered from the Australian supplier and is expected to be operational in March 2007.

Moreover, the project teams are conducting thorough literature searches on various aspects of drying and storage that are proposed under similar climatic and socio-economic conditions in other coffee producing areas. The most attractive solutions will be considered and, if adequate for the conditions prevailing in PNG, incorporated in the experiments.

Devise and implement strategies for the adoption of system improvements.

At this stage it would be premature to propose concrete solutions. However, some of the findings from experiments conducted at the UNSW with samples obtained from PNG as well as those from northern NSW may be included in strategies to be trialled in the field by the PNG team.

ASEM/2004/042: Assessing and extending schemes to enhance the profitability of the PNG coffee industry via price premiums for quality

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Curtin University of Technology, Agribusiness Marketing (Horticulture), Australia
Project Leader	Dr Peter Batt Email: p.batt@curtin.edu.au
Collaborating Institutions	PNG Coffee Industry Corporation, Papua New Guinea
Project Budget	\$541,502
Project Duration	01/04/2005 to 31/03/2008 (Project extended from 01/04/2007 to 31/03/2008)
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Coffee growers in PNG fall into two broad sectors; the estate comprising block-holders and plantations and the smallholder sector. Of the two it is the smallholder sector that produces the majority of PNG's coffee. Smallholder farmers account for 85 per cent (56,100 tonnes) of production. The estate sector has been in decline for most of the past two decades, producing only 9,900 tonnes.

The export of coffee is an important component of PNG's economy. Ten per cent of all PNG exports are from coffee, generating five per cent of GDP. Almost 400,000 rural households grow coffee and 20,000 people are employed in the processing and marketing areas. Despite this importance PNG's reputation as a quality producer, which underpins export market access is under question. The estate sector built this reputation for some of the world's leading quality coffee. However, the decline of the estate sector has corresponded to the decline in reputation, and thus premiums, that PNG coffee is now experiencing.

Some smallholder producers are still commanding price premiums, through their involvement in several collaborative marketing arrangements. Producers are establishing long-term working relationships with suppliers paying premiums in return for quality coffee. This is a departure from current practices of paying a single price regardless of quality, guaranteeing a return to smallholders but in turn sacrificing overall quality. The alternative arrangements of groups of growers linked to processors suggest that tying price to quality can deliver quality when the working relationship provides sufficient market signals and information.

Supply chain improvements also help, returning some of these benefits to smallholders. Project objectives are to improve the economic returns to PNG smallholder coffee producers and the industry, through delivering a more consistent and higher quality product, by examining arrangements linking smallholders and processors.

Project Progress

Year 2 (01/04/2006–31/03/2007)

Over the last 12 months, this project has:

1. undertaken and prepared a Participatory Rural Appraisal and Planning report for each collaborative marketing scheme participating in this pilot program
2. explored the relationships between actors in the PNG coffee industry
3. delivered an introductory HACCP-based training course for the selected schemes
4. developed and verified a generic HACCP-based quality management program for the PNG coffee industry
5. identified barriers to the adoption of quality assurance systems among smallholder coffee farmers in PNG
6. developed pilot training modules on the marketing of coffee and mechanisms to improve the quality of smallholder coffee
7. updated numerous training manuals prior to the delivery of training programs identified and prioritised by the PRAP process

8. presented several papers to international research forum on the PNG coffee industry.

Some 6–9 months into the project, the project team identified the need to adopt the Participatory Rural Appraisal and Planning (PRAP) approach developed by the Department of Agriculture and Livestock and utilised by the Coffee Growers Support Services Division. PRAP is a participatory planning process conducted within villages or communities which establishes needs and develops action plans for collaborative farmer groups.

The PRAP process involves three stages:

- a description and analysis of the community through village mapping, seasonal activity calendars and history profiles
- problem identification and solution generation through a Strengths, Weaknesses, Opportunities and Constraints exercise, problem listing and problem ranking
- the design and programming of training activities to resolve the problems identified.

The PRAP has identified the need for five generic training programs; a marketing module (5 days); a financial management module (10 days); an agronomy module (21 days); a postharvest and quality module (21 days); a pest and disease control module (15 days). While these five modules will form the core of the training program, additional modules on nursery management and writing project proposals have been requested. While these modules will be developed by CRI, the training itself will be delivered by sub-contracted training providers.

In order to facilitate and monitor not only the training process but also the dynamics associated with the management of each group, a staff member from CRI and the regional extension office have been assigned to each group. There is within the literature strong empirical support for the need to understand the group dynamic processes if collaborative marketing groups are to prosper. Although the issue of group leadership and transparency was not raised by any of the groups themselves, training on 'personal wellness' will be delivered to each group by the CRI. There is already some evidence of this project contributing to the re-introduction of self-governing community laws to curb cherry theft, alcoholism, drug abuse, gambling and the spread of HIV AIDS.

The generic HACCP plan developed for the PNG coffee industry has identified two critical control points in the PNG coffee industry. Both are associated with chemical residues from (1) the application of chemicals on-farm and the harvest of cherry before the prescribed withholding period and (2) contamination from chemical residues in the packing of containers for the export market.

Under the current systems of production, contamination at the grower level is unlikely. Providing that appropriate standard operational procedures are implemented to ensure that containers are cleaned before packing, the likelihood of contamination occurring during transportation is equally remote. At the farm level, constraints to improving quality have been identified as; (1) the lack of labour; (2) the lack of water; (3) the lack of electricity; (4) the lack of capital to build/construct wet mills at the village level; (5) the inability of collaborative farmer groups to pay the farmers for cherry on receipt; (6) traditional practices; and (7) poor roads.

Over the last 12 months, with the harvest in PNG falling well below expectations, the need to secure coffee to meet forward contracts has led to record cherry prices. Not unexpectedly, the incidence of cherry theft has escalated to such an extent that CIC has been forced to explore various options for the registration of growers and cherry traders. Such mechanisms are already inherent within the quality control programs necessary for registration under Fair Trade, organics and the Starbucks Café Practices quality assurance scheme.

However, it is also abundantly clear that within the coffee processing sub-sector, many of the wet mills are paying premium prices for poor quality cherry that is unlikely to achieve the specifications demanded by the specialty coffee segment. Furthermore and with regard to the existing quality regulations, there is a mismatch evident between the standards as defined by physical parameters such as size, colour and moisture content and the intangible quality attributes such as taste, body and aroma required by the specialty coffee market. As such attributes are highly subjective, they are difficult to communicate.

ASEM/2004/047: Sustainable management of coffee green scales in Papua New Guinea

Multilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	CAB International, UK
Project Leader	Sean Murphy
Collaborating Institutions	PNG Coffee Industry Corporation, Papua New Guinea University of New South Wales, Australia
Project Budget	\$621,960
Project Duration	01/04/2006 to 31/03/2009
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

Coffee is the largest earner of foreign exchange within the PNG agricultural sector (> 43% of PNG agricultural exports and 10% of total exports). Primarily produced by smallholders in the highlands (397,000 families and 85–90% production in 2003), with few management inputs, productivity is hampered by inadequate pest management as well as by deficiencies in quality management and marketing.

With the latter problems being addressed by other ACIAR projects, this project is developing and fostering uptake of biological control and other integrated strategies for coffee green scale (CGS - *Coccus celatus* De Lotto and *C. viridis* (Green) (Hemiptera:Coccidae)), a pest capable of causing up to 50% yield reduction in some instances.

The scale insects colonise leaves and stems of the plant, closely adhering to them. Although immobile, they avoid attack by natural enemies because they are guarded by ants that drink their honeydew, the partially digested plant juices that flow quickly through the digestive tract of the pest. The quality of bean is likely to be affected by CGS, since quality depends on bean density and during ripening there is often a critical shortage of nutrients to fill the bean sufficiently before harvest comes.

In consultation with smallholders, the PNG Coffee Industry Corporation (CIC) has confirmed the urgent need to develop and introduce integrated management systems for coffee green scale.

Currently the European Union (EU) is supporting CIC to develop capacity for research in integrated pest management (IPM) and biological control of CGS, but this effort (provision of facilities, equipment, training, access to parasitoids) needs the complementary R&D supplied by this project.

Objectives of this project are:

- to document baseline information on the distribution, impacts, biology and control of CGS in the coffee-growing zones of PNG
- to evaluate biological and other control methods of CGS, taking into account grower information
- to develop regional and national strategies for wider evaluation and implementation of CGS control.

Project Progress

Year 1 (01/04/2006–31/03/2007)

Baker and Murphy travelled to PNG Aiyura in October 2007 to hold start-up workshops. Objectives of the visit were to:

1. formally open the project with all main project partners
2. agree key milestones within main project objectives
3. establish sampling methods for CGS and socio-economic surveys
4. establish priorities and methodologies for ecological studies
5. establish a viable work-plan for the first 6 months of the project
6. establish responsibilities for specific work-plan actions.

An intention of the project is to capitalise on synergies with the two other ACIAR-funded coffee projects being carried out at the same time: ASEM/2004/042 on marketing and PHT/2004/017 on postharvest quality management. To this end a joint meeting was held at Aiyura in February 2007 under the facilitation of Tony Marsh.

The joint meeting established that the combining of the socio-economic surveys, together with the work already carried out by Batt & Murray-Prior, are the main areas of synergy for the present project.

This was subsequently discussed at length with CIC personnel and it is clearly established that parts of socio-economic surveys serve all projects. From the discussions, it seems clear from Batt & Murray-Prior's work that the socio-economic limitations on coffee production presently dwarf any biotic or abiotic constraints.

Transport and labour shortages, combined with a significant coffee theft problem in some areas (berries stolen from trees) must conspire to limit smallholders' interest in investing more time in coffee to increase yields – by controlling pests and diseases for example.

The socio-economic state of affairs may impact on this project, since costly and/or time-consuming ways of controlling CGS are very unlikely to be adopted. A very simple form of IPM could be beyond the majority of smallholder farmers; even if substantial efforts were put into farmer training, it seems unlikely that they would adopt any measures that involved extra work since other constraints are so great.

This suggests that the emphasis on classical biocontrol is perhaps the best policy to adopt. CGS seems to presently have the most noticeable effect on seedlings, which suffer a high mortality through CGS attack. If CGS control by classical biocontrol is successful, coffee production would rise and replanting costs would fall for no additional farmer inputs. If later campaigns to replant coffee were to be realised, effective control of CGS would be a boon.

When coffee berry borer (CBB) arrives in PNG (it could be soon, it is very close to the PNG border) farmers at all but the highest altitudes will have to invest more time in their crop if they are to get any sort of return from growing coffee. This will entail more pruning to control the size of trees to make them easier to manually control the CBB infestations. If CGS is not under control, it will most likely cause great difficulties by attacking the new growth flushes.

The CGS team has made good progress on the survey, having recently hired an entomologist to take charge of rearing and making progress with preparing stock plants and laboratory facilities to receive future shipments of parasitoids. If work continues to advance on this over the next few months, the team should have some good baseline data on socio-economic parameters. Some initial experimental exclusion work could be started to sort out methodological problems.

But efforts should concentrate on making culture facilities ready to receive regular parasitoid shipments with a considerable and compatible stock plant material of citrus and gardenia – i.e. a similar scheme to that successfully employed in Australia. This especially since, after the socio-economic surveys of Batt et al., biological control seems even more than before to be the most viable way of controlling this pest for the smallholder. In other words there is little chance of any time-consuming or product-based approach being adopted by the majority of smallholder farmers. Curtailed field work during election times should allow plenty of time to concentrate on the improvement of laboratory rearing conditions and to analyse the recent survey.

ASEM/2006/033: PNG coffee project coordinator

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Project Leader	Mr Anthony Marsh
	Phone: 07 4696 8139
	Email: tonymarsh@ozemail.com.au
Project Budget	\$45,012
Project Duration	01/07/2006 to 30/06/2008
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

The purpose of this small R&D activity is to coordinate a flow of key information between the three ACIAR coffee projects, ASEM/2004/042, ASEM/2004/017 and ASEM/2004/047 in PNG, with the Contract Manager identifying synergies where possible, without unduly burdening any project with extra bureaucracy.

Project Progress

Year 1 (01/07/2006–30/06/2007)

Four ACIAR missions were made by the consultant to PNG during the period.

The consultant conducted a review of the Collaborative Marketing Project (ASEM/2004/042) from 17 to 31 July 2006 for ACIAR, just prior to his contract as 'Coordinator'. This review mission gave the consultant good background knowledge of the ASEM 2004/042 and the key partner CRI (Coffee Research Institute)

The first coordination mission to PNG, from 11 to 15 Oct 2006, was timed to coincide with the inception mission of the Green Scale Project ASEM/2004/004.

The Second coordination mission to PNG, from 4 to 11 Feb 2007, was timed to coincide with the inception mission of the Post Harvest project ASEM/2004/017. This mission also coincided with visits by the team leaders for the Collaborative Marketing Project and the Green Scale Project. A half-day coordination meeting for the three coffee projects was held on the 7 Feb 2007.

The third coordination mission to PNG from 27 May to 6 June 2007, focused on the Post Harvest Project activities, in coordination with CRI staff from both the Green Scale and Collaborative Marketing projects.

Coordinator Reports

Three Coordinator Mission reports were submitted during the period.

Project Annual Reports

Annual reports were submitted by the Green Scale Project and the Collaborative Marketing Project during the period. These were read by the Coordinator. The annual report for the Post Harvest project was not due in this report period.

Coordination of the three ACIAR Coffee projects

The key activity was the combined project meeting in February of the three ACIAR coffee projects. Semi-formal presentations were made by each project leader about their respective projects with inputs from various team members and CRI staff. Good discussion was held around each project with good involvement from CRI staff, and all key staff involved in the project presentations.

The meeting was attended by:

- Dr Peter Baker, of the Green Scale Project, (ASEM/2004/047)
- Dr Peter Batt and Dr Ron Murray-Prior of the Collaborative Marketing Project (ASEM/2004/042)
- Dr Robert Driscoll, Dr Wendy Shaw and Mr. Anthony Marsh of the Post Harvest project (ASEM/2004/017)
- Steve Layton of AT Projects, who arrived at the end of the meeting and gave a presentation of AT Projects' work in PNG
- All key CRI staff from each of the projects.

CP/2004/064: Biological control of 'mile-a-minute' (*Mikania micrantha*) in Papua New Guinea and Fiji*Bilateral*

Overseas Collaborating Countries	Fiji, Papua New Guinea
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Michael Day Phone: 07 3405 5530 Email: michael.day@dpi.qld.gov.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, Papua New Guinea Oil Palm Research Association, Papua New Guinea Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea
Project Budget	\$579,018
Project Duration	01/01/2006 to 31/12/2008
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Papua New Guinea and Pacific Island Countries (PICs) are becoming increasingly concerned about the occurrence, spread and impact of weeds on the region's food crops (such as taro, sweet potatoes, yams, bananas, papaya and green vegetables) and cash crops (cocoa, vanilla, sugarcane, kava and oil palm). By affecting yields, some introduced weeds directly affect food security and income and impact on the natural ecosystem functions. However, most Pacific islands lack the technical capacity to prevent the introduction of serious weeds or manage them effectively.

This project is tackling one of the Pacific's most important weeds (as ranked by the 2004 meeting of Pacific Heads of Plant Protection) – mile-a-minute (*Mikania micrantha*). Mikania is a major problem throughout the Pacific. Solomon Islands, Niue and Vanuatu have infestations, but it is particularly severe in PNG and Fiji.

In PNG, mikania is already one of the major weed invaders of farms in several provinces. It can form a dense ground cover, out-competing other ground species such as sweet potato and yams, or can grow up and over garden crops, such as taro, papaya and lowland coffee, completely smothering vegetation and causing loss of production and localised death of these crops. In plantations, mikania can grow up into the canopy of plantation trees, completely smothering them, interfering with harvesting of coconuts, oil palm or cocoa pods.

The weed has also become a significant weed in young cocoa and vanilla plantations in East New Britain, and young oil palm plantation in West New Britain.

In Fiji, mikania is a serious weed in mature taro and kava plantations and is one of the major weeds in sugarcane farms on both Viti Levu and Vanua Levu. In many areas, farmers cannot afford costs of manual or chemical weed control.

This project is implementing a classical biological strategy, building on past and ongoing biocontrol projects supported by ACIAR and others in the Asia-Pacific region. The aim of the project is to develop sustainable methods for control of mikania, as well as to increase capacity in the South Pacific by improving biocontrol agent-rearing facilities (for insects and pathogens).

Project Progress**Year 1 (01/01/2006–31/12/2006)**

All project personnel were appointed or assigned. Jonacani Ratutini (Project Technical Officer) and Livai Vakatikati (Labourer) were appointed by the Fiji, Ministry of Agriculture; Sarah Pene (Technical Officer) was appointed by SPC and Ingu Bofeng (Scientist) was appointed by NARI, PNG.

ACTIVE PROJECTS

The biocontrol rearing laboratory at Koronivia Research Station (KRS) in Fiji was upgraded prior to project commencement for host-screening and mass rearing work. Twenty cages were constructed in Australia and shipped to Fiji.

A workshop was conducted at the KRS in July, with participants from SPC, Ministry of Agriculture and Qld Natural Resources and Water. All aspects of the project were discussed including budgets, activities, milestones and reporting.

A database has been established and the distribution of mikania in PNG and Fiji is being recorded. Surveys and herbarium records suggest that there are over 150 sites in Fiji and nearly 50 in PNG where mikania is present. It is estimated that there are many more sites than this and the database will continually be updated as staff locate more sites through surveys or through the awareness program.

Monitoring sites to assess growth rates and percent cover of mikania prior to releasing agents were established at three sites on Viti Levu (Nadi, Koronivia Research Station and Naduruloulou Research Station); one site at Vuma village on Ovalau Island and one site at the Taveuni Coconut Center (TCC) on Taveuni Island. Assessments are being conducted on a monthly basis.

Mikania plants and 35 species of host-testing plants were propagated and are being maintained in the nursery area at KRS. The butterflies *Actinote anteas* and *Actinote thalia pyrtha* were imported into the quarantine unit at KRS. Dr Roch Desmier de Chenon from Indonesia hand carried the agents and supplied training to SPC and KRS staff. The colony of *A. anteas* was lost after two generations. Host testing of *A. thalia pyrtha* has now commenced, with three species now tested.

The host-specificity screening of the 3rd biological control agent the rust *Puccinia spegazzinii* has been completed by CABI in the UK. The rust failed to develop on all plants except *M. micrantha* from Fiji and PNG, suggesting that the rust is safe for importation. An Import Risk Analysis to support an Application for Import was completed and submitted to the Fiji Quarantine and Inspection Service in November 2006. A decision is pending.

Warea Orapa and Michael Day attended the 7th *International Workshop on Management of Chromolaena odorata and Mikania micrantha* at the National University of Pingtung, Taiwan. A joint poster was presented, as well as project and country reports. A project meeting with Carol Ellison from CABI was also held to discuss the work on the rust.

SMCN/2000/046: Overcoming magnesium deficiency in oil palm crops on volcanic ash soils of Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	CSIRO Land and Water, Davis Laboratory, Australia
Project Leader	Ms Suzanne Berthelsen Phone: (07) 4753-8534 Email: suzanne.berthelsen@csiro.au
Collaborating Institutions	Oil Palm Research Association, Papua New Guinea James Cook University, Australia
Project Budget	\$917,638
Project Duration	01/07/2002 to 30/09/2007 (Project extended from 01/07/2007 to 30/09/2007)
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

Palm oil is the most valuable agricultural commodity in Papua New Guinea (PNG); in the year 2000, it was worth about A\$152 million. About 60 per cent of production is in West New Britain Province, which has coarse volcanic soils and an annual rainfall of more than 3000 mm. Oro Province is also an important producer of palm oil. Most palms in both regions suffer from leaf yellowing, which is usually a symptom of magnesium (Mg) deficiency and which results in decreased yields. Many soils are also deficient in potassium (K) and nitrogen (N).

In most parts of the world, Mg deficiencies can be corrected by applying kieserite, a soluble Mg fertiliser. However, this is not effective in West New Britain, probably because a high concentration of calcium in the soil causes Mg to leach rapidly through the soil when it is applied in soluble form. The application of nitrogen exacerbates the problem.

In other parts of PNG, kieserite also fails to solve the problem, evidently because high rainfall makes it difficult for the Mg to remain in the root zone for long enough to have an effect. In both areas, the problems affect other crops as well as oil palms.

The aim of this project is to increase yields of oil palm in Papua New Guinea (PNG) by finding suitable ways to overcome deficiencies in magnesium (Mg) and other elements. In particular, the project will help oil palm plantations to predict the areas likely to be susceptible to Mg deficiency and to choose the best solution for the particular soil and climatic conditions.

Project Progress

Year 4 (01/07/2005–30/06/2006)

The field trials established in 2003 and 2004 (Waisisi, Walindi and Kumbango in WNB, and Mamba in Oro) are progressing well and now have at least 2 years of yield-recording data following treatment applications. The trials at Waisisi, Kumbango and Mamba are not yet demonstrating differences in yield due to treatments.

At Waisisi, an estimate of nutrient export associated with bunches demonstrated no significant differences between treatments at this stage, and while there was no treatment difference in bunch oil content there did appear to be progeny differences.

At Walindi, the application of the various Mg products has significantly increased yield compared to the control, although there is no difference between the different forms of Mg at this stage. Soil samples collected at Walindi show that there were large increases in exchangeable Mg in the surface soil due to the applications of the Mg products, but interestingly even after 3 years of fertiliser application there was very limited vertical movement of Mg through the soil profile with any of the products, including the very soluble kieserite. This lack of vertical movement was not because there was no potential to do so, as sulfate (from the kieserite) had moved to greater than 0.7 m depth (maximum sampling depth).

ACTIVE PROJECTS

Three new field trials were established during this reporting period, a Mg leaching trial at Dami, West New Britain, a N x K and K placement trial in Milne Bay, and a Mg x K factorial trial using a range of different Mg and K products at Hargy, West New Britain. In the 'leaching' trial established at Dami, kieserite (MgSO_4), magnesite (MgCO_3), partially calcined magnesite (MgCO_3/MgO) and fully calcined magnesite (MgO) were spread evenly over an area of 4 m^2 . After 45 days and 745 mm rainfall, all plots were sampled to 1.5 m depth, and analysed for soil Mg, $\text{SO}_4\text{-S}$ and pH.

Similarly to the field trial at Walindi, there was very little vertical movement of Mg through the soil profile. In contrast the soil $\text{SO}_4\text{-S}$ moved readily to depth. Infiltration rates, bulk density and water retention curves were determined on samples collected throughout the soil profile and this data, together with adsorption isotherms measured on the same soil type, was used to model water and Mg movement using HYDRUS-2D. The modelling of both this Dami trial and the Walindi field trial supports the soil analyses, and suggests that the applied Mg is being held very tightly by the surface layer.

A modelling approach, as described above, will be used to 'test' alternatives (type of fertiliser product, placement etc.) in other areas and different soil types. To this end, an extensive sampling exercise was carried out during this reporting period to characterise the representative predominant soil types in most of the oil palm growing areas of PNG. Samples were collected from Ramu Valley (three profiles), West New Britain (one profile at Hargy, one at Waisisi, one at Kumbango, one at Dami), Poliamba (two profiles), Milne Bay (two profiles).

At each site, a pit was dug and the soil was described and divided into horizons based on pedological characteristics such as colour and texture. Saturated infiltration rates were measured in each major horizon. Undisturbed cores for physical analyses (bulk density and water retention curves) were collected from the same depth increments, as were samples for chemical analyses (pH, electrical conductivity, exchangeable cations, cation exchange capacity, cation adsorption isotherms). Scientific and social impacts of the project have accrued through the experimental results and through the various training activities.

Papuan New Guinean scientists, university students and extension and field staff have benefited from workshops and training in soil science, plant nutrition and related subjects. In addition, Steven Nake, Assistant Agronomist with PNG Oil Palm Research Association was awarded an ACIAR John Allwright Fellowship to undertake study towards a Masters degree at James Cook University in Cairns. Steven's studies will examine 'Potassium availability in clay soils of Papua New Guinea'.

SMCN/2006/031: Analysis of nutritional constraints to cocoa production in PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	James Cook University, School of Earth Sciences, Australia
Project Leader	Dr Paul Nelson Phone: 07 4042 1375 Fax: 07 4042 1284 Email: paul.nelson@jcu.edu.au
Collaborating Institutions	National Agricultural Research Institute, Lowlands Agricultural Experiment Station, Papua New Guinea Cocoa Coconut Institute of Papua New Guinea, Cocoa Research Division, Papua New Guinea Curtin University of Technology, School of Social Sciences, Australia
Project Budget	\$100,316
Project Duration	01/04/2007 to 30/11/2007
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

Cocoa is a primary cash crop in many coastal areas of PNG, bringing in export earnings of around K200 million annually. But yields fall far below the theoretical productive potential for dry beans of 11 tonnes per hectare per year. Higher yielding hybrids are planted in some areas, but typically decline after reaching maximum production five to seven years after planting, and this seems strongly linked to nutritional problems.

The objective of this study is to provide a compilation of biophysical and socioeconomic data as a basis on which to recommend future soil fertility RD&E investment and crop management in PNG's cocoa production systems.

Project Progress

First progress report due in 2008.

PLIA/2005/148: Papua New Guinea coffee and cocoa policy linkages scoping study

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Centre for International Economics, Australia
Project Leader	Dr Derek Quirke Phone: 02 62457800 Fax: 02 62457888
Project Budget	\$47,500
Project Duration	12/12/2005 to 31/08/2006
ACIAR Research Program Manager	Dr Jeff Davis

Project background and objectives

This scoping study aims to assess the policy and institutional environment affecting the development of the coffee and cocoa industries in PNG, and advise on whether this environment is likely to have an impact on current and potential ACIAR projects and the nature and potential significance of these impacts.

The study will advise if a policy linkage/economic analysis project is required for each industry to complement technical projects, and identify key personnel involved in policy formulation and decision-making relevant to the issues raised in order to suggest people to engage with and involve in future policy linkage projects.

This scoping study should result in the development of an SRA on policy linkage for the coffee and cocoa industries.

Project Outcomes

Final report not yet submitted by the Commissioned Organisation.

PLIA/2007/019: A review of the future prospects for the world coconut industry and past research in coconut production and product development: Implications for ACIAR's future directions for coconut research

Bilateral

Overseas Collaborating Countries	Papua New Guinea, South Pacific general
Commissioned Organisation	Centre for International Economics, Australia
Project Leader	Dr Robert Warner Phone: 02 6245 7800 Fax: 02 6245 7888 Email: bwarner@thecie.com.au
Project Budget	\$33,300
Project Duration	15/03/2007 to 31/05/2007
ACIAR Research Program Manager	Dr Jeff Davis

Project background and objectives

ACIAR has supported research to help the coconut industry in the Asia-Pacific Region over many years. This study arose after a request from the ACIAR Board of Management, who wished to define the place of coconuts in ACIAR programs and also which part of the value chain ACIAR should focus on.

Project Outcomes

Final report not yet submitted by the Commissioned Organisation.

FIS/2001/083: Inland aquaculture in PNG: improving fingerling supply and fish nutrition for smallholder farms

Bilateral

Overseas Collaborating Countries
Commissioned Organisation
Project Leader

Papua New Guinea
 University of Western Sydney, Australia
 Dr Paul Smith
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 Email: pt.smith@uws.edu.au

Collaborating Institutions

National Fisheries Authority, Papua New Guinea
 Highland Aquaculture Development Centre, Papua New Guinea
 Department of Agriculture and Livestock, Papua New Guinea
 Queensland Department of Primary Industries and Fisheries,
 Australia

Project Budget

\$774,751

Project Duration

01/01/2005 to 31/12/2008

ACIAR Research Program Manager

Mr Barney Smith

Project background and objectives

Aquaculture is a growing industry in Papua New Guinea (PNG). Fish can provide both income and food protein but in inland areas rivers there are not high numbers or diversity of species to support these needs. Farming of fish, or aquaculture, is one avenue through which supply can be lifted. A previous ACIAR project examined the aquaculture industry in PNG.

A survey of 313 farms, as well as hatcheries, institutions and markets, revealed approximately 11,000 active fish farms. This was almost double the 6000 estimated to be in operation prior to the survey's findings. Three types of farms are in operation – those of newcomers to the industry who are yet to harvest, established farmers and pioneers of the industry. One thing most have in common is never having received training in fish aquaculture.

The survey, together with a workshop of key stakeholders, identified the main issues for research to support the industry. Of these issues two will be addressed in this follow-on project. Demand for fingerlings to fill ponds is extensive, with current supply able to meet only 10 per cent of this. The distribution network for the industry is a limiting factor, along with protocols to support hatchery operations and broodstock management. Nutritional feeds to help rear fingerlings are also in short supply. Manufactured pellet feeds are expensive and leave smallholders seeking other material.

Local ingredients that support the growth of fish and utilise materials that can be prepared on-farm are also needed to support the industry's expansion.

The project is working to improve the productivity (and profitability) of smallholder fish farmers in inland PNG. The long-term outcome will be increased dietary protein and better nutrition for farmers, their families and inland communities.

Project Progress

Year 2 (01/01/2006–31/05/2007)

This is a project with a national focus, and in the last 12 months smallholder farmers, NGOs and government officers from a range of Lowland Provinces have attended two project Workshops at Erap's Aquaculture Centre to receive training and extension of skills. The major events that have occurred during the last 12 months are as follows.

At Erap (Lowland Aquaculture Facilities of NDAL)

Newly recruited technical officer (TO) Billy Kerowa has been learning the skills for operating fish ponds and assisting in the construction of a GIFT hatchery. Billy travelled to Aiyura for further training – particularly in using pH, dissolved oxygen, salinity meters and loggers.

Ten co-operator farms have received tools (shovels, etc), and a first introductory workshop was held in February 2006. At another workshop in August 2006 the farmers carried out activities that are part of the 'Halpim long pis farma' (i.e. fish husbandry package).

ACIAR held a feed workshop at Aiyura in November 2006 where participants received training on making pellet fish feed.

At Aiyura (Highland Aquaculture Development Centre of EHP Government)

The TOs, Hopa Simon and Wally Solato, worked on feed trials and broodstock respectively. Hopa received training at a Feed workshop in Thailand but has since left the project. She had carried out excellent work in 2005 to identify the cause of fingerling mortalities during transport. Also she started investigating the usefulness of seeds from Elephant grass as a feed for GIFT fish in a 100-day experiment using triplicates for a range of treatments. These need to be verified. Wally received training on broodstock at SPC in Fiji and has prepared 5000 fingerlings for the SPC-ACIAR project in Yonki Reservoir.

Eastern Highlands Province (EHP) administration has worked out a plan for meeting its own needs and the commitments to ACIAR for Aiyura and Yonki, especially the cage culture project.

The Technical Advisor, Mr Nephion Tarapi has been successful in getting funds from EHP Government to improve the water supply to the Aiyura Highland Aquaculture Development Centre (HAQDEC). Kevin Lange, the Australian volunteer (AVI) from Tasmania, arrived in March 2006 and has assisted the team with water installation, repair of vehicles, general back-up and technical advice.

Further work on a whole range of 'nil cost' feeds is expected during the project once the team can meet and make a plan. The team received training for preparing pellet feeds using the feed machinery from Geoff Allan's project. Funds are needed to purchase ingredients and maintain this important initiative.

Efforts are being made to organise a farm-based workshop in the Highlands. The Project Leader travelled to the highlands in October 2006 and selected three co-operator farms in the Goroka area in an effort to encourage the team to select the remaining co-operator farms.

The project has instituted a 'Siot long wokim' (shirt for work) program, and has so far provided shirts for the Lae soccer team which carried out activities at Erap station and after the work, the team received the ACIAR-sponsored football shirts. There are two football teams in Aiyura wanting to participate in the program – a boys and girls' team – who will be outfitted in the same way.

FIS/2004/065: Culture of promising indigenous fish species and bioremediation for barramundi aquaculture in northern Australia and PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Australia
Project Leader	Dr Evizel Seymour Phone: 07 4092 9913 Email: evizel.seymour@dpi.qld.gov.au
Collaborating Institutions	James Cook University, Australia Ok Tedi Mining Ltd, Papua New Guinea National Fisheries Authority, Papua New Guinea Western Provincial Administration, Papua New Guinea
Project Budget	\$781,587
Project Duration	01/06/2006 to 30/06/2011
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Lack of animal protein in the diet of people in the highlands of PNG is the main factor in poor children's development. Attempts to diversify animal protein sources for highland communities have met with limited success, but aquaculture has the potential to provide dietary protein in inland areas of PNG, with small or no cash inputs. Native species have a number of advantages for culture in the area – they are pre-adapted to local conditions, and are familiar to and favoured by the people.

Recently, many aquatic species have become extinct in parts of Western Province, but at present there is no capacity in PNG to culture native species. Indeed, the potential of native species in aquaculture has largely been overlooked.

In Western Province, particularly in the densely inhabited north-west sector near the Ok Tedi mine, there is a crucial need to develop alternative livelihoods for mine-affected communities when the Ok Tedi mine closes in 2012.

An ACIAR exploratory project (C2003/149) found interest and willingness from Ok Tedi Mining Ltd (OTML) Food Security Programs, Western Province (WP), National Fisheries Authority, and local pond owners to commit resources to native fish/crustacean aquaculture.

This project builds on the work of the earlier exploratory project which identified several promising candidates for aquaculture, and opportunities and partners for hatchery development.

Objective 1 is to develop robust hatchery and growout techniques for indigenous fish species to support sustainable aquaculture in both Queensland and PNG. Objective 2 is to evaluate potential of pond-based crustacean aquaculture in PNG and Queensland, building on techniques already developed in Queensland for these species. Objective 3 is to assess the acceptance by farmers of the new species and techniques, and develops appropriate husbandry packages.

Project Progress

Year 1 01/06/2006–31/05/2007

Work has commenced on all aspects of the objectives of this project. There have been some major changes to staff at the Freshwater Fisheries and Aquaculture Centre (FFAC) Walkamin, Queensland and OTML.

- Project Leader resigned (Dec 06), replaced (Mar 07)
- Technician at FFAC commencement date delayed until Dec 06
- Project Co-ordinator at OTML commenced a PhD (May 07) at JCU, replacement commenced (June 07).

Ok Tedi Mining Limited (OTML) and Western Province main component's objectives have been to:

- establish some ponds for holding broodstock
- identify model farmers
- provide training.

The ponds have been constructed and stocked with native broodstock. The native species identified as having good aquaculture potential and restocking are:

- Eel tailed catfish – Able to live and grow in high density, appears to be omnivorous, benthic feeding. Hatchery techniques being developed at FFAC.
- Fly River herring – Potential as fodder food, fish meal and human consumption. Plankton eater, therefore can be produced with other species e.g. redclaw crayfish and sleepy cod. OTML looking into a potential source of fish meal for fish, poultry and pig pellets.
- Sleepy cod – Able to live and grow in high density, benthic feeding, demersal spawner. High market potential as good eating.
- Redclaw crayfish – Breed in ponds, requires simple food, can be farmed in high densities and easily transported live. Aquaculture techniques transferable from FFAC
- Sooty grunter – Omnivorous. Excellent eating fish with potential for market development. Small-scale hatchery techniques already developed. FFAC has extensive experience in low-tech breeding techniques, weaning, spawning. Potential for restocking.

The plans for the two hatcheries are under way, although there has been some delay due to changing the location from Tabubil to Kiunga and priority changes from in-country partner. Two staff members from the Western Provincial Government and one farmer from the Tabubil area have been identified to attend training in Australia in Nov 2007. Some model farmers have been identified.

The Australian components main objectives have been to:

- investigate the aquaculture potential of two strains of the Australian giant freshwater crayfish (*Macrobrachium rosenbergii*)
- transfer and adaptation to PNG of techniques developed in Qld for native fish aquaculture
- bioremediation in partitioned pond systems.

FFAC collected *M. rosenbergii* broodstock were on two field trips (Nov & Dec 2006). These broodstock were successfully spawned at James Cook University (JCU), Townsville using the most recent developments in hatchery practice (clear water culture). The juveniles have been stocked into a pond at FFAC Walkamin.

The bioremediation ponds have successfully been constructed and stocked with barramundi (*Lates calcarifer*) at high stocking density and inoculated with duckweed (*Spirodela* spp.), a floating aquatic plant native in both PNG and Australia that has high protein content and provides a high protein animal feed or supplement when dried.

OTML staff involved in the ACIAR project visited FFAC (funding from Crawford Scholarship) to undertake a feeding trial for *Cherax quadricarinatus*, comparing readily available food in PNG. Four replicates of six treatments were set up with 25 animals stocked in each cage.

The treatments were: hay, raw coarsely cut sweet potato, raw finely cut sweet potato, cooked sweet potato, sweet potato peels and formulated redclaw pellets (the control). The animals were fed to satiation every other day with the feed amounts offered adjusted every alternate day. Water quality was monitored.

Crayfish grew the best on hay although results showed no significant difference between feed types. Slower than usual growth could be attributed to the colder weather experienced at the time as well as not having a significant amount of time, 6 months cut back to 3 months.

FIS/2006/138: Developing aquaculture based livelihoods in the Pacific Islands region and tropical Australia

Bilateral

Overseas Collaborating Countries	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
Commissioned Organisation	James Cook University, Department of Marine Biology and Aquaculture, Australia
Project Leader	Dr Paul Southgate Phone: (07) 4781 5737 Fax: (07) 47812 6136 Email: paul.southgate@jcu.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, New Caledonia WorldFish Center, New Caledonia University of the South Pacific, Fiji
Project Budget	\$1,229,663
Project Duration	01/10/2007 to 30/09/2011
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

As a component of the previous ACIAR project (FIS 2001/75 *Sustainable aquaculture development in the Pacific Islands region and northern Australia*), managed by QDPI&F a total of 14 'mini-projects' were successfully implemented. The mini-project concept was a novel approach to target specific bottlenecks to regional aquaculture. They led to significant capacity-building and generated widespread support for their continuation. The final project review in November 2006 specifically recommended that ACIAR consider funding a follow-on project to extend the mini-project concept.

The overall aim of the project is to support economically, socially and environmentally sustainable aquaculture in the Pacific Islands region, and to assist indigenous aquaculture in tropical Australia. The project will support the SPC's Regional Aquaculture Strategy and supplement the R&D activities of the SPC Aquaculture Action Plan.

The specific objectives are to:

- Identify and implement targeted research activities and technology transfer in response to priority issues identified by Pacific Island Countries (PICs), where possible by drawing on results and expertise developed through completed and on-going ACIAR, WorldFish and other aquaculture projects
- Increase institutional capacity amongst Pacific Island Countries (PICs) to support and manage research, particularly Papua New Guinea
- Provide technical support for indigenous Australian aquaculture ventures.

Project progress

First progress report due in 2008.

FIS/2001/075: Sustainable aquaculture development in Pacific Islands region and northern Australia

Bilateral

Overseas Collaborating Countries	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, South Pacific general, Tonga, Vanuatu
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Agency for Food and Fibre Sciences - Fisheries and Aquaculture, Australia
Project Leader	Dr Mike Rimmer Phone: 07 4035 0109 Fax: 07 4035 6703 Email: mike.rimmer@dpi.qld.gov.au
Collaborating Institutions	Secretariat of the Pacific Community, New Caledonia WorldFish Center, New Caledonia
Project Budget	\$862,019
Project Duration	01/01/2004 to 30/06/2007 (Project extended from 01/01/2007 to 30/06/2007)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Aquaculture in the Pacific has been characterised by low production levels and few success stories. The main export commodities are non-food products (pearls and seaweed) due in large part to long transport distances and high costs. Food production has been hampered by the familiar barriers to aquaculture – post larval fish capture and culture having high mortality rates and issues of sustainability and reseeding in sea harvesting.

Research has significantly advanced in terms of overcoming these barriers. ACIAR-supported research has addressed some of these issues in grouper aquaculture in Indonesia, developing methodologies applicable elsewhere, including the Pacific Islands. These countries are ideally suited to a range of aquaculture activities, having large, clean and sheltered areas of seawater and high biodiversity. The Secretariat of the Pacific Community (SPC) has a Pacific Aquaculture Program in place to ensure the continued development of aquaculture in the region.

In part this aims to address the reliance of most aquaculture developments on aid donors and domestic government agencies for assistance. The SPC Program will utilise the opportunity to link in with completed and on-going ACIAR and Worldfish work on sea cucumber, including reseeding and post-larval capture and culture of aquaculture species.

The results of some of this research will also be applicable for aquaculture in Australian waters, particularly far north Queensland. The project is providing support to the SPC Pacific Aquaculture Program's strategic development of economically, socially and environmentally sustainable aquaculture in the Pacific Islands region, by:

- identifying and implementing targeted research activities and technology transfer to assist the development of sustainable aquaculture in the Pacific Island region
- extending the outcomes of completed and ongoing ACIAR and WorldFish projects to other communities/countries in the Pacific Islands and northern Australia.

Project outcomes

During the course of the project, fourteen (14) miniprojects were approved and funded. Examples of outcomes include:

- Identification of the viral disease status of *Penaeus monodon* shrimp stocks in Fiji, leading to the development of improved quarantine and testing procedures

CONCLUDED PROJECTS

- Demonstration that the native freshwater prawn *Macrobrachium lar* can be successfully cultured in ponds in Pacific Island countries as an alternative to the introduced *M. rosenbergii*
- Improvements in husbandry for artisanal fish farmers in PNG and Fiji, provided through formulation of cheap, locally available fish feeds
- Fisheries Officers and university students in Fiji trained in specialised techniques for collecting juvenile eels
- Improved cage culture techniques for fish farmers in the PNG Highlands, resulting from trials comparing fish density and feeds for caged tilapia in a freshwater reservoir
- Improved sponge culture methods in Solomon Islands and investigation of markets for Pacific bath sponges. An EU-funded follow-on project will support a farming operation to produce sufficient quantities of sponges for marketing.

However, the most important was capacity building, as technical advisors provided expert skills. Local farmers and aquaculture officers learnt how to collect and/or breed and culture species such as Nile tilapia, indigenous freshwater prawns, anguillid eels and sponges. Fisheries officers also increased their skills in a wide range of areas including feed formulation, feed management, mabe pearl production, survey techniques, water quality monitoring and data recording.

Capture and culture of pre-settlement coral reef fishes and invertebrates (PCC)

Outputs from the PCC component include: (i) consolidation of PCC operations in the Western province of Solomon Islands, where the methods were developed; and (ii) extension of the techniques to other Solomon Islands' Provinces and three other PICs.

The principal success in technology transfer was in Western Province, Solomon Islands. This was due to several factors, primarily proximity to the WorldFish Center facility at Gizo (and the relevant expertise that resides in that centre). The first training workshop for the community and National Fisheries Officers in PCC techniques was held at WorldFish in June 2004. Soon after, two Western Province villages began catching and rearing post-larval tropical lobster, cleaner shrimp and fish.

In 2005 and 2006, training was carried out in Isabel Province, although start-up was constrained by problems with reef access and transport to markets. Exports of shrimp, lobster and fish to the Honiara-based aquarium fish exporter have generated income of ~SB\$23,000 (approx. AU\$3,800) since the first training workshop.

Training workshops were held in Fiji (three visits), Kiribati (one visit) and Tonga (one visit). In Fiji a village has been identified with high potential and community members fully trained. Although not yet at commercial stage, USP is assisting with development of the fishery. Fisheries officers in Kiribati and Tonga received the basic skills to determine if the methods have potential for their country.

An important output of the PCC component has been in increased capacity of the Solomon Island WorldFish Center project staff. And the final tangible output was production of a methods manual featuring illustrations by a Solomon Island artist.

Sea cucumber aquaculture/reseeding

Outputs from the sea cucumber hatchery production component include:

- increased skills of project staff at DPI&F Northern Fisheries Centre (NFC) in Cairns, Australia
- capacity-building in hatchery techniques for Pacific Islands' hatchery technicians (PNG and Tonga)
- assessments of the potential for use of sea cucumbers for bioremediation in Australia
- support for studies by an Australian / PNG post-graduate student at James Cook University into nutrient utilisation by sea cucumbers.

CONCLUDED PROJECTS

Sandfish (*Holothuria scabra*) is a new species for NFC. The project constructed hatchery facilities and trained three DPI&F staff members in all aspects of broodstock management, spawning, larval rearing and juvenile grow-out, and now three successful hatchery runs have been completed. Two PNG trainees attended the second hatchery season and were fully trained in production techniques, while two Tongan Fisheries Division aquaculture officers were trained in the third and final hatchery season. The project also supplied juvenile sandfish to an Australian/PNG student at James Cook University to run feeding trials.

The project contributed to knowledge of the growth and survival of sea cucumbers in coastal shrimp/effluent/bioremediation ponds. Adult sandfish did not grow in an operational shrimp culture pond and bioremediation channel, most likely because of unsuitable substrata. There seems little potential for co-culture of sandfish with shrimp in far northern Queensland. Juvenile sandfish were kept in bag nets in shrimp farm bioremediation channels, intake channels and earthen ponds (without shrimp). Juveniles grew well in the intake channel, survived but did not grow well in an earthen pond, and did not survive in the bioremediation channel.

Overall, these results indicate that sandfish are not suitable as a bioremediation species for Australian shrimp farms. However, small juveniles can be on-grown in the comparatively clean waters of unused shrimp ponds and intake channels using techniques developed by WorldFish. Additionally, juvenile sandfish may be grown-out to commercial size using extensive methods in large ponds with minimal inputs. A final trial will grow-out sandfish produced at NFC in late 2006 in an unused shrimp pond, and will be completed in early 2008.

FIS/2006/001: Increasing capacity for regional fish feed manufacture in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	NSW Department of Primary Industries, Port Stephens Fisheries Centre, Australia
Project Leader	Dr Geoff Allan Phone: 02 4916 3909 Fax: 02 4982 1107 Email: geoff.allan@dpi.nsw.gov.au
Collaborating Institutions	National Fisheries Authority, Papua New Guinea
Project Budget	\$48,664
Project Duration	01/06/2006 to 30/11/2006
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Inland aquaculture in PNG is set on a slow growth path despite approximately 11,000 small aquaculture farms. Major constraints of this activity comprise access to fingerlings and feeds manufacturing. At present, there is no manufacture of aquaculture feeds in the country and imported ones are very expensive.

This ACIAR project focuses on building capacity of farmers in basic fish nutrition and feed manufacture and on-going support to establish four regional feed manufacturing centres at selected areas. These feed manufacturing centres will act as feed distribution centres in order to link feed production with fingerling distribution. Yet, the project will help farmers increase their understanding of the fish nutrition and feeding and their skills of aquaculture feeds in PNG.

Project Progress

First progress report due in 2007.

FST/2003/049: Review of portable sawmills in the Pacific: Identifying the factors for success

Bilateral

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	Australian National University, School of Resources, Environment and Society, Australia
Project Leader	Dr Ryde James Phone: 02 6125 4330 Fax: 02 6125 0746 Email: ryde.james@anu.edu.au
Collaborating Institutions	Secretariat of the Pacific Community, Fiji University of Melbourne, Australia Papua New Guinea Forest Authority, Papua New Guinea Papua New Guinea Ecoforestry Forum, Papua New Guinea University of Technology, Papua New Guinea Ministry of Forestry, Environment and Conservation, Solomon Islands Solomon Islands Development Trust, Solomon Islands
Project Budget	\$149,989
Project Duration	01/04/2005 to 30/09/2007 (Project extended from 01/10/2006 to 30/09/2007)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Portable sawmills are cheaper to use than conventional mills, causing less collateral damage than conventional harvesting. One important benefit is in allowing small-scale operators to undertake high-quality sawmilling and gain much of the value added in the production of milled forest products. These benefits saw more than 7000 portable mills purchased throughout the Pacific. Less than 20 per cent are believed to be operating effectively.

A lack of technical expertise, poor maintenance and market accessibility are behind this low rate. These causal factors are being evaluated by studying a range of mill operations to design strategies for more effective usage. Appropriate recommendations will then be provided to key stakeholders for dissemination.

Project Progress

Final report not yet submitted by the Commissioned Organisation.

FST/2004/009: Facilitating the availability and use of improved germplasm for forestry and agroforestry in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Mr Brian Gunn Phone: 02 6281 8258 Fax: 02 6281 8266 Email: brian.gunn@csiro.au
Collaborating Institutions	Queensland Department of Primary Industries and Fisheries, Australia Papua New Guinea Forest Research Institute, Papua New Guinea The Foundation for People and Community Development Inc., Papua New Guinea
Project Budget	\$627,169
Project Duration	01/04/2005 to 31/03/2008
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Harvesting of native, primary forests has been an important export industry for Papua New Guinea (PNG). Logs are exported mainly by foreign logging companies, providing very substantial returns totalling hundreds of millions of Kina. This money flows to the PNG Government, local communities and landowners.

Continued harvesting has depleted primary forests, but those areas replanted with secondary forests have produced less reliable yields. As primary forests are rapidly depleted the likelihood of lost income earnings is growing nearer.

This is despite a growing international demand for sustainably produced high-value timber. Papua New Guinea has extensive areas well suited to growing trees, with – a climate favourable for several in-demand species, good soils and knowledge of forestry and agroforestry to support potential new plantings.

The knowledge of forestry and agroforestry systems has grown from a tradition of tree planting by communities and families. While the plantation sector lacks the scope to expand in a significant way smallholder community-based and family-based plantations and agroforestry enterprises do have the capacity to expand.

One element that will support this growth is developing community tree planting programs. This includes providing germplasm for high-value timber species and training in propagation undertaken in this project; it being one of several designed to address issues relating to expanding community involvement in agroforestry.

This project has two main aims: firstly, to improve and make available selected tree germplasm and planting stock for use in forestry and agroforestry in Papua New Guinea and humid tropical parts of Australia; and secondly, to empower PNG rural communities to raise their own trees.

Project Progress

Year 2 (01/04/2006-31/03/2007)

The project is now into its second year of operation with significant activities having been achieved. Key highlights cover the establishment of a Kamarere seed orchard, teak clone bank, and Kamarere conservation clone bank, establishment of *E. pellita* and *A. crassicarpa* seed production areas and seed production in the *Calophyllum euryphyllum* progeny trial. A number of village nurseries were established by villagers following training by Project Partners.

Information on progress against each of the three objectives is summarised below.

Objective 1. Establish and maintain germplasm populations for 10 tree species

A teak conservation clone bank was established at PNG Forest Research Institute in Lae comprising 18 out of the total of 30 clones represented in the Mount Lawes clonal seed orchard. The orchard is considered the most complete and best collection of genetically selected teak in the country.

The orchard established in the 1970s has been under continuing threat, making the need to conserve the existing germplasm a high priority. So it has been seen as a high priority that the germplasm, considered the most complete source of germplasm in PNG be conserved.

Further attempts will be made in 2007 to capture the other 120 clones plus selected trees (six) from East New Britain. The key outcome over time is to produce sufficient grafted plants to establish a new seed orchard as part of meeting the country's anticipated seed requirements. It is also proposed to produce sufficient grafted plants from each clone to establish a new seed orchard.

Two taun (*Pometia pinnata*) seed stands were established as a future source of seed. Seed was sourced from Madang and Manus seed. These seed sources were selected on the basis of their desirable fruit characteristics. Work is continuing on developing grafting techniques for this species. Current success rate is around 33% using tip cleft grafting.

The team has already established 246 seedlings of Indian sandalwood (*Santalum album*) in the FRI nursery ready for planting. This represents the only known resource of this highly prized sandalwood in PNG. It is proposed to produce additional plants to extend the resources to enable project collaborators to access seedlings for their own use. Work on PNG sandalwood (*S. macgregorii*) is ongoing but frustrated by a lack of suitable germplasm and unsuccessful attempts to produce new plants by grafting.

The NG walnut (*Dracontomelon dao*) provenance trial at Bumsi near Lae has been thinned to remove 50% of inferior trees, thereby converting the trial into a future seed source stand. Growth assessments have been used to provide some data on growth performance for this species.

The *Calophyllum euryphyllum* progeny trial at Bumsi produced a seed crop and subsequent regeneration. This stand which is now 5 years at time of seeding can now produce bulk quantities of seed suitable for growers to use.

Seed stands of *Eucalyptus pellita* and *Acacia crassicaarpa* have been established at Ramu and Bulolo. The seed used for establishment of these stands is derived from seed orchards of superior genetic quality. It is hoped that these stands will produce quality seed in three to four years in addition to the *A. mangium* seed stand established previously near Madang.

The species trial at Lae Botanical Gardens continues to be well maintained and has the potential to provide valuable information on comparative growth rates. *Terminalia complanata* and *Elmerrillia papuana* have shown outstanding growth performance. An assessment of growth and survival performance has been made by FRI staff.

Objective 2. Training rural communities in nursery practices and planting seedlings

Project Partner organisations, in particular Foundation for People Community Development (FPCD), provided training to six village communities. Each trainer has conducted follow-up training in order to reinforce and evaluate the implementation and impacts of nursery skills within their respective villages.

During their training workshops each trainer conducted a baseline survey amongst village growers on tree species priorities and desirability of trees. OISCA and CPL trainees are also using the training provided under the project to develop their own nursery facilities. A series of nursery training aids were developed to include wall posters illustrating nursery techniques in both English and Pidgin.

Objective 3. Eucalypt germplasm development

3a. Establishment of a new Eucalyptus deglupta seed orchard

A new *E. deglupta* seed orchard has been established at Bulolo. The orchard is represented by clonal material sources from the old Bulolo CSO (19 clones), six grafted selections from the Philippines progeny trial at Bulolo, five selections from the Bulolo seedling seed orchard and seedlings derived from 11 candidate plus tree selections in . Seedling are currently being raised from seed derived from xxxPlus tree selections in Solomon Islands.

3b. Development of hybrid between E. deglupta x E. pellita.

xx 67 ramets representing xx 25 clones ex old Bulolo CSO have been established in the FRI nursery grounds. These will be used as a resource for carrying out the controlled pollination crosses with *E. pellita* once flowering occurs. It is hoped that this will occur by early in 2008. The trees can also be used to carry out other controlled pollination work or other research activities.

3c. Eucalypt hybrids in Queensland.

Pollen has been collected from select *E. pellita* trees for controlled pollination on *E. deglupta* as mentioned in 3b, and to continue the hybrid crossing program in Queensland. Controlled pollinations were made at two separate sites using different species as both male and female parents. One site has been seriously drought-affected for the past few years which contributed to low capsule retention. Pollinations carried out at the second site have resulted in successful capsule set. Seed should be ready for harvest by October 2007.

FST/2004/050: Value-adding to PNG agroforestry systems*Bilateral*

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Australian National University, School of Resources, Environment and Society, Australia
Project Leader	Professor Peter Kanowski Phone: 02 6125 2667 Fax: 02 6125 0746 Email: peter.kanowski@anu.edu.au
Collaborating Institutions	Papua New Guinea Forest Authority, Papua New Guinea Papua New Guinea University of Technology, Papua New Guinea PNG Sustainable Development Program Ltd, Papua New Guinea Village Development Trust, Papua New Guinea Papua New Guinea Ecoforestry Forum, Papua New Guinea
Project Budget	\$912,087
Project Duration	01/04/2007 to 31/03/2011
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

After more than 30 years of unsustainable commercial exploitation of PNG's natural forests, the contribution of forestry to PNG's local and national economies will soon start to diminish significantly. International markets for a number of high-value tree species that are already grown or have potential in PNG are expected to remain favourable, therefore market opportunities will start to emerge for planted trees of these species. This mirrors the transition from a natural to a planted forest resource base that has been experienced elsewhere.

Everywhere in PNG tree growing and management of trees are incorporated into both traditional and modern farming systems. However, because there has been little incentive to focus on species of commercial forestry value, often such species are ignored. Where a critical mass of resource can be established, commercial tree-growing appears a good prospect for landowners with limited income-generation alternatives.

This project is framed in these contexts. It draws from current knowledge, including prior ACIAR work, to assist PNG landowners in targeted pilot regions to adopt commercial tree-growing. An ACIAR pilot project earlier identified suitable candidate regions and partners, together with tree species and production systems.

This project aims to foster the adoption of commercial-scale high-value tree growing by landowners of PNG. Its objectives are to:

- define commercial tree production systems for priority species in pilot regions
- assess landowner decision-making in the context of candidate tree species and production systems
- develop business models and strategies to facilitate adoption, in conjunction with investment and implementation partners – businesses, government, NGOs & CBOs (community-based organisations)
- implement strategies in the pilot regions in conjunction with landowners and investment and implementation partners
- communicate project knowledge and learning to interested parties outside pilot regions.

Project Progress

First progress report due in 2008.

FST/2004/055: Domestication and commercialisation of *Canarium indicum* in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea, Solomon Islands
Commissioned Organisation	James Cook University, Agroforestry and Novel crops Unit, Australia
Project Leader	Dr Tony Page Phone: 61 7 4042 1673 Fax: 61 7 4041 1319 Email: tony.page@jcu.edu.au
Collaborating Institutions	National Agricultural Research Institute, Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea Commodities Export Marketing Authority, Solomon Islands Kastom Gaden Association, Solomon Islands Pacific Nuts Co., Vanuatu
Project Budget	\$634,571
Project Duration	01/01/2006 to 31/12/2009
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

A feasibility study of domesticating and commercialising the canarium nut in Papua New Guinea affirmed the positive attributes of *Canarium indicum* – a high value, nutritious, premium product, with good processing attributes. An industry could be built on traditional use, existing markets and recognised livelihood benefits. Nuts are easy to store, and processing is simple. The large tree-to-tree variability in key kernel traits emphasises the potential for cultivar selection. The soft nut texture is popular and allows a broad range of uses in confectionery/baking, and the nuts have health attributes, making them a part of healthy living in Melanesia.

The survey underscored the benefits of developing an industry in Melanesia. All rural people surveyed use *Canarium* as a food, with 80% wanting more. With 2 million people consuming 2 kg per head per year of kernels, domestic consumption could be 4000 tonnes valued at \$A100 million.

The researchers recognised opportunities for year-round production in Melanesia, with growing urban markets (local and expatriate) in PNG, Solomon Islands and Vanuatu. There was great enthusiasm among producers, traders and tourist outlets around the region, with opportunities for regional and international niche market expansion. Several other indigenous nuts were found to have similar opportunities.

This project aims to seek out, characterise, select and multiply individual *Canarium* trees in PNG that have superior commercial traits for cultivar development and field tests. It also aims to improve market prospects for these products in PNG, Solomon Islands and Vanuatu, deliver selected cultivars and training to the participating communities, and disseminate information to stimulate adoption.

Project Progress

Year 1 (01/01/2006–31/12/2006)

Milestone 1.1: Vegetative propagation (Achieve 50% rooting in stem cuttings by month 6 and 80% rooting by month 12).

Canarium indicum (Galip Nut) has a reputation of being very difficult to root from stem cuttings, and little is known about how to propagate this species vegetatively. However, good progress has been made towards this Milestone.

In the first set of experiments, set in September 2006, the overall level of rooting was 40%, but the breakdown of this result by different treatments and by cutting position shows that the cuttings with the optimum combination of treatments exceeded 40%. This was achieved with cuttings from seedlings in which maintenance could be easily improved, thus future experiments should achieve greater levels of success.

The limited availability of suitable juvenile cutting material led to a second set of experiments undertaken in February 2007, using cuttings from mature trees. As would be expected this material did not root well. However, now at the end of the first year, the project has a number of different sets of juvenile stockplant material both in the nursery and in stockplant gardens. A series of replicated shade and nutrient treatments were applied to these stock plants in May 2007 and Richard Pauku will return in August–September to set the cuttings.

It is expected that this third set of cutting experiments using the best combinations of rooting hormone (0.8% IBA), media (soil), leaf area (80 cm²) and cutting length (3-node) will result in high (>80%) rooting success. This experiment should also clearly demonstrate the benefits of high quality stockplant management and the impacts of stockplant environment on rooting.

New nursery facilities have been developed in the station, which will improve the capacity of NARI nursery staff to maintain a high quality propagation environment. This new facility combined with the availability of high quality stockplants will help to improve the environmental conditions of the propagating environment and the physiological condition of the cutting, which is likely to result in a higher percentage of rooted cuttings.

The use of marcotting (air-layering) techniques on mature trees has been successfully used to propagate superior phenotypes for the establishment of mature stockplants for future studies. Currently marcotting success is around 50%. The development of this capacity in NARI will assist in securing the selected individuals identified through the characterisation study.

Milestones 1.2, & 1.3: Prospect village populations, characterise phenotypic variation in nuts and kernels. Milestones 1.4 And 1.5: To select superior trees and propagate by marcotting.

Twelve populations from five provenances have been visited and 600 suitable trees have been identified during a survey to collect dried leaf samples for molecular analysis. Village communities were informed of the study and a good rapport has been fostered with those participating landowners.

A further 100 *Canarium* trees have been identified and marked at two villages in East New Britain (Nanuk near Kokopo, and Kabaira near Keravat). A third site (Welmeki, near the border with West New Britain) to be visited soon was selected because the community has been reported to have good success using Galip as the shade in cocoa plantations, which may contribute to our understanding of *Canarium* productivity in mixed plantings.

The lack of fruiting over the last two seasons (main and minor seasons) has resulted in the delaying of the prospecting and characterisation. It was considered more astute to delay the collection to a time when there was prolific fruiting to ensure assessment of a wide range of individuals and enable the preliminary identification of high-yielding trees.

The prolific flowering of Galip trees across a range of different sites in May 2007 indicates that the next season is likely to have sufficient nuts to carry out the characterisation field work. The collecting teams are currently contacting the relevant landowners in the five Provinces (Madang, New Ireland, Bougainville, East and West New Britain) and preparing for the field work expected to be carried out in August–September 2007.

Milestones 2.1 & 2.2: Facilitate national workshop to promote exchange of cultivation and marketing information linked with Solomon Islands and to develop a Melanesian supply chain.

Communications with industry stakeholders throughout Melanesia has continued and while volume and consistency of supply continues to restrict industry growth, various strategies are being implemented to improve local supply. Such activities include promotion and use of small food dehydrators in the villages, improved packaging to extend shelf life, development of food processing training within the new Santo Agricultural College

ACTIVE PROJECTS

To maximise the effectiveness and impact of this workshop negotiations with Sunshine Coast University have been ongoing to link with their proposed ACIAR-funded project workshop focusing on Galip processing.

While industry stakeholders have indicated their support for this, it does mean that the proposed workshop will be delayed until the commencement of the Sunshine Coast project (expected in January 2008). Given that the results from the field survey will be available by this time it is envisaged that this will also form a valuable component of the workshop.

Milestone 4.1: Dissemination of information to stimulate adoption.

- Article published in National newspaper on 'The potential of Galip in PNG'
- NARI Extension leaflet 'Toktok on Galip'
- NARI Extension bulletins on outputs from ACIAR Feasibility Project
- Farmer survey results
- Consumer survey results
- Galip literature review
- NARI Field Day – April 23rd 2007 focused on Galip promotion. There were radio and TV presentations from the Open Day
- Regional Research Advisory Council Meeting – 25 April 2007 involved stakeholder groups from different regions of PNG.

7.2 Subprogram 2: Sustainable management of forestry and fisheries resources

Projects

Active

ASEM/2004/011	Evaluating domestic tuna fisheries projects
FIS/2001/036	Maximising the economic benefits to Pacific Island nations from management of migratory tuna stocks
FIS/2005/096	Assessment of the impact of the PNG purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices (FADs)
FST/2004/061	Assessment, management and marketing of goods and services from cutover native forests in PNG forests

Concluded

FIS/2002/056	Biology and status of the prawn stocks and trawl fishery in the Gulf of Papua
FIS/2006/133	Study to evaluate options and opportunities to improve management arrangements for sea cucumber fisheries in PNG
FST/1998/118	Planning methods for sustainable management of timber stocks in Papua New Guinea's forests

Pipeline

FST/2006/088	Promoting diverse fuel wood production systems in PNG
FST/2006/120	Increasing downstream value-adding in PNG's forest and wood products industry

FIS/2001/036: Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks

Bilateral

Overseas Collaborating Countries	Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
Commissioned Organisation	La Trobe University, School of Economics, Australia
Project Leader	Dr John Kennedy Phone: 03 94792313 Fax: 03 94791654 Email: j.kennedy@latrobe.edu.au
Project website	http://www.business.latrobe.edu.au/staffhp/jkennedy/ACIARTechPapers.htm
Collaborating Institutions	University of Queensland, Australia Secretariat of the Pacific Community, New Caledonia Forum Fisheries Agency, Solomon Islands
Project Budget	\$577,584
Project Duration	01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

Stocks of tuna migrate through the exclusive economic zones (EEZs) of island nations in the Western and Central Pacific Ocean. The migratory nature of the tuna means that no nation has control over the tuna stocks. Over the last decade the proportion of Pacific tuna caught by island nations has risen substantially and, at the same time, the level of purse seining by distant water fishing nations has also risen significantly.

A bioeconomic model (developed in an earlier ACIAR project) of the Pacific tuna fishery has been used by the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) to identify and analyse various concerns associated with increased purse seine catching. One of the negative impacts identified is that increased purse seining reduces catch of larger (older) and higher priced tuna caught by longliners and sold fresh.

A second concern identified with the model is that the traditional method of charging the purse seine fleets of distant water fishing nations for access to the EEZs of the Western and Central Pacific Ocean (WCPO) is not maximising the flow of annual rents from tuna harvesting to island nations. A third issue is that excess vessel capacity has built up in the fleets that harvest the tuna, which has led to economic inefficiencies in harvesting.

The project is identifying and promoting strategies for Pacific Island Nations to maximise the economic benefits from their migratory tuna stocks.

Project Progress

Year 5 (01/01/2006-31/12/2006)

Objective 1: Updating and extending the capability of the bioeconomic tuna model

In Subproject 1e) Updating economic parameters, Chris Reid incorporated revised price elasticities of demand by fleet, species and gear type in the large scale bioeconomic model. The determination of the revised elasticities was laid down in Project Technical Paper 1.

Objective 2: Analyse strategic policy options facing the nations of the Forum Fisheries Agency (FFA)

In Subproject 2a) Appraisal of effort and catch reduction systems, a paper titled *Further development of, and analysis using, the Western and Central Pacific Ocean Bioeconomic Tuna Model (WCPOBTM)* was released as Technical Paper No. 2, downloadable on the Project website (<http://www.business.latrobe.edu.au/public/staffhp/jkennedy/index.htm>).

The paper details the structural updating to the population dynamics and the harvest model carried out in 2005, and changes to the revenue model carried out in 2006. It also contains an analysis of the effect of effort and catch reductions conducted with the updated model which is compared with results obtained with the previous model described in 2000.

The results of the analysis indicate that if an across-the-board effort reduction were implemented in the WCPO, the total level of rent generated for the WCPO tuna fishery as a whole is likely to increase, but that the net benefits gained are likely to be disproportionately borne by particular fisheries and jurisdictions. The purse seine fishery within the waters of FFA members is likely to see the least proportionate gains, while the high-seas frozen longline fishery is likely to see the largest net benefits from such an action.

Actual outcomes are likely to be more detrimental to FFA member countries with a significant purse seine fishery in their waters than the analysis indicates, as the model does not take into consideration the benefits gained from processing activities or employment associated with the purse seine fishery which are not associated with the high-seas longline fishery. The adoption of management measures by the Western and Central Pacific Fisheries Commission (WCPFC) is likely to have substantially different economic outcomes for different fleets and Commission members.

To overcome the difficulties inherent in obtaining agreement on implementing management measures, members of the WCPFC will need to give serious consideration to the use of 'negotiation facilitators' or 'side-payments' in order to ensure that the costs and benefits of any such management measures are borne equitably between members.

John Kennedy presented a paper at the International Institute of Fisheries Economics and Trade (IIFET) 2006 Conference at the University of Portsmouth in the UK on policy options for management of highly migratory fish stocks in the Western and Central Pacific. The goals of the recently established Western and Central Pacific Fisheries Commission were outlined. Statements by the Commission suggest that in the longer run Convention Area total allowable catches (or total allowable effort levels) are likely to be imposed in exclusive economic zones and high-seas sub-regions.

The role of bioeconomic optimising models in helping to determine these is canvassed. They are important for indicating which harvesting parties gain and which lose from the introduction of new measures, and are thus likely to be useful in the determination of Convention Area total allowable catch allocations. The paper was presented in a special session 'Management of High Seas Fisheries' chaired by Professor Gordon Munro, a specialist in the area of the United Nations Fish Stocks Agreement on managing migratory stocks.

FIS/2005/096: Assessment of the impact of the PNG purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices (FADs)

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Secretariat of the Pacific Community, Oceanic Fisheries Programme, New Caledonia
Project Leader	Dr John Hampton Phone: 687 260147 Fax: 687 263818 Email: johnh@spc.int
Collaborating Institutions	National Fisheries Authority, Papua New Guinea University of Hawaii, USA
Project Budget	\$400,000
Project Duration	01/05/2006 to 31/12/2009
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The tuna fishery in Papua New Guinea — the largest in the Pacific Islands region, is based on total allowable catches allocated by species type (skipjack, yellowfin and bigeye tuna) and gear type (purse seine and longline). Overfishing of tuna stocks, due in part by the use of anchored fish aggregation devices (FADs), may have a negative impact on the sustainability of the tuna fishery in the region.

The objective of this ACIAR's project is to manage the sustainability of the tuna fishery by providing information on tuna population dynamics and fishery impacts for the use of FADs. The project will provide information on the impacts of fishing in the PNG Exclusive Economic Zone that will constitute the basis for appropriate management actions by the PNG National Fisheries Authority (NFA) and contribute to regional stock assessment and fishery management.

Project Progress

Year 1 (1/5/2006–31/5/2007)

The major objectives of the PNG Tagging Project are:

To obtain information on the large-scale movement of tuna in, and from, the PNG EEZ.

This information is important for understanding the relationship of PNG stocks with those of adjacent areas. Movement rates are particularly important for assessing the potential for interaction between fisheries operating in different areas.

The comparison of tagged fish movements from the Bismarck Sea (an area of major anchored FAD deployment) that will result from this project with tagged fish movements from the same area in the early 1990s (before extensive anchored FAD deployment) will provide important new information on the meso- to large-scale effects on tuna movement of large anchored FAD arrays.

To obtain information on current exploitation rates of tuna in the PNG EEZ.

Information on local exploitation rates is important for understanding the impact of fishing at the EEZ scale. In particular, it allows estimation of the extent to which current catch levels may reduce the standing stock of tuna and the catch-per-unit-effort of the fisheries, a phenomenon commonly known as 'local depletion'.

To obtain information on the dynamics of tuna associations with FADs, in particular species-specific information on residence times, vertical and horizontal movements and FAD interactions.

This information is required for a better understanding of the effects of FADs on tuna stocks and their vulnerability to fishing, and for the design of appropriate management measures.

To obtain data that will contribute to regional tuna stock assessments.

Conventional tagging data are an important component of tuna stock assessments, providing quasifishery-independent information on exploitation rates, natural mortality, movements and other parameters.

To obtain information on the trophic status of free-swimming schools of tuna, and tunas associated with FADs, other floating objects and seamounts.

This information is required for the general understanding of the ecosystem impacts of FADs compared to other types of tuna aggregations.

To characterise the variability and extent of catches of by-catch species from purse seine catches in PNG.

NFA runs an observer programme with high coverage rates, which offers the opportunity to document by-catch levels and their variability in purse seine sets on anchored FADs and other set types.

These objectives are being pursued through a tagging program and associated data collection activities in PNG waters. This progress report presents the results of the second of two three-month cruises by the chartered pole-and-line tagging vessel *Soltai 6*, owned and operated by Soltai Fishing and Processing Ltd, a Solomon Islands-based company. The report of the first three-month cruise, undertaken during August–November 2006, is available at <http://spc.int/oceanfish/Html/TAG/index.htm>.

The operational objectives of this second and final cruise were:

- To tag and release 15,000 tuna (i.e. half the project target of 30,000 tuna) using conventional tuna tags, with an ideal species composition of skipjack 60%; yellowfin 30%, and bigeye 10%
- To increase the spatial distribution of tag releases already achieved during Cruise 1 throughout PNG waters
- To tag and release 200 plus tuna using electronic archival tags, with a priority on bigeye and yellowfin tuna
- To undertake sonic tagging and deployment of FAD monitors using methodology developed during Cruise 1 in 2006
- To train scientific staff, including two full-time PNG biological technicians, on tagging and sampling methods, including archival/sonic tagging procedures and data management

- To undertake biological sampling (length, sex, stomach contents and tissue samples) according to an experimental design in order to obtain information on the trophic status of tunas in different school associations.

Additional activities related to tag recovery were undertaken separately from the activities of the tagging vessel.

Summary of results

The Cruise (and the second charter) began with the departure of the *Soltai 6* from Noro, Solomon Islands, on February 19 2007. Tagging operations proper began in PNG on February 20, with a productive fortnight in the Solomon Sea before spending six weeks fishing most parts of the Bismarck Sea and adjacent areas, then returning to Noro on May 20 via the Solomon Sea and waters east of Bougainville.

During Cruise 2, a total of 39,064 tuna were tagged with conventional yellow tags of two sizes, 212 with archival tags and 160 with acoustic tags. Archival and acoustic-tagged tunas were also conventionally tagged. During Cruise 2, 68% of releases were anchored FAD-associated fish, compared with 80% during Cruise 1.

Tag recovery arrangements are working and survival of fish following tagging is assumed to be good. As at 30 June 2007, 603 tag recoveries had been received from the Cruise 2 releases for an overall recovery rate of 1.5%, consistent with the much higher proportion of releases away from the intensively fished Bismarck Sea. Over 20,000 releases (>50%) were made in the Solomon Sea and in waters east of Bougainville. Cruise 1 recoveries stood at 4071 (18.2%), with 4675 recoveries overall (7.6%) for the combined releases (approx. 62,000) on the two cruises.

FST/2004/061: Assessment, management and marketing of goods and services from cutover native forests in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Melbourne, School of Forest and Ecosystem Science, Australia
Project Leader	Professor Rod Keenan Phone: 03 5321 4124 Fax: 03 5321 4166 Email: rkeenan@unimelb.edu.au
Collaborating Institutions	Village Development Trust, Papua New Guinea Papua New Guinea Forest Research Institute, Papua New Guinea Australian National University, Australia
Project Budget	\$783,318
Project Duration	01/05/2007 to 30/04/2010
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Forest resources are a major contributor to different sectors of the PNG economy. The log export industry alone contributed some Kina 200 million to the national economy in 2003, but its current level of harvesting is unsustainable and accessible primary forest is likely to be logged out in the next 15 years.

Properly managed, however, PNG's forest resources could continue to make a major, sustainable contribution to the PNG economy, while maintaining many of the qualities that PNG society values from its forests. ACIAR's forestry strategy for PNG, developed in collaboration with PNG colleagues, is designed to promote a positive vision for PNG forestry.

This project, a key element of the strategy, aims to improve the contribution that PNG's secondary forests make to national and local economies by developing appropriate strategies for their management and marketing. Project outputs will complement broader work on marketing of PNG timber, under consideration by the International Tropical Timber Organisation (ITTO) and others.

Specific objectives are to:

- Classify PNG's secondary forests in terms of condition and capacity for future growth and to produce timber and other products and services

- Assess the future market opportunities for different products and develop effective methods for linking local producers with purchasers of sustainably produced timber
- Analyse options for future supply in collaboration with forest owners, based on supply of different products and taking into account their community and external market values, and to design appropriate management and marketing strategies
- To train community-based NGO staff in forest assessment and analysis of different forest management options that will allow local forest owners to obtain future sources of revenue from their forests.

Project Progress

First progress report due in 2008.

FIS/2002/056: Biology and status of the prawn stocks and trawl fishery in the Gulf of Papua

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	CSIRO Marine Research, Australia
Project Leader	Dr Alan Butler Phone: 07 3826 7200 Fax: 07 3826 2582 Email: alan.butler@csiro.au
Collaborating Institutions	National Fisheries Authority, Papua New Guinea University of Tasmania, Australia
Project Budget	\$479,680
Project Duration	01/07/2003 to 31/12/2006 (Project extended from 01/07/2006 to 31/12/2006)
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

The Gulf of Papua Prawn fishery currently catches between 400 and 650 tonnes of banana prawns and upwards of another 160 tonnes of Black tiger prawns each year that are worth about K15 million. This catch is spread among 15 vessels that each land between 25 and 70 tonnes of prawns. Overall catch rates are low compared with northern Australian prawn fisheries. Formal assessment of the status of the fishery has been hampered by poor quality logbook data and a lack of an adequate time series of catches and catch rates in order to undertake such an assessment.

Recent rises in fuel costs at the same time as prawn prices were falling has severely impacted the economic viability of the fishery when catch rates are low. Fishing in the Gulf is overseen by the National Fishing Authority (NFA), who recently allocated 10 new licenses for a small inshore prawn fishery, but little was known about the potential biological and economic impacts of the uptake of these licenses.

This project was designed to equip NFA managers to plan for sustainable management, based on the best economic and biological options. A previous ACIAR-supported project that examined management of the prawn fisheries had recommended a cap on industrial fishing and a change from management by 'total allowable catch' to 'effort targets'. This and other changes instituted in data collection established a basis for assessment in this new project.

The project aimed to develop and evaluate management strategies and policies for the profitable and biologically sustainable utilisation of the Gulf of Papua prawn resources. The specific objective of the project was to assess the biological status and impact of varying fishing strategies and levels of effort on prawn resources, including assessment of the potential impact of a small boat (inshore) fishery on the 'offshore' fishery and building of capacity for biological research and fishery management in PNG.

Project outcomes

This project and its companion ASEM/2002/050 determined that the recent catches of about 550 tonnes of banana prawns were biologically and economically unsustainable and that the fishery should aim to catch about 480 tonnes per year to maximise the biological and economic productivity of the prawns in the Gulf of Papua. Also, the number of fishing licences should be reduced to 8–10, to improve the returns to each operator.

CONCLUDED PROJECTS

One of the consequences of the extensive data compilation during the project has been to improve the level of interaction and trust between the fishing companies and the National Fisheries Authority (NFA). The project has recommended the appointment of an industry liaison officer dedicated to collection of vessel logbooks and company landings, to capitalise on the improved relations. This should enable NFA to improve the fleet coverage and expedite data processing. This officer would also provide data summaries to each company, enabling it to better track the status of the prawn resource.

Other recommendations include changing the licence period from one to five years and allowing licences to be tradable. Fishing season opening dates should also be adjusted according to the total catch in the previous year, and be shortened when the catch exceeds the 480 tonne catch limit. These real-time active management options are now possible following the dramatic improvements in the data entry, error checking and catch summation processes introduced during the project.

Another project objective was to assess the potential for an independent fishery (inshore of the 3 nautical mile closure zone) undertaken by small vessels run by the local community. Three fishery-independent surveys were made throughout the Gulf of Papua fishing zone and inside the closure to measure the distribution and abundance of each species of prawns each March between 2004 and 2006.

These surveys provided an index of abundance of each prawn species and demonstrated the large population of prawns inside the 3-nautical mile (nm) closure zone. These prawns were a mixture of recruit-sized and adult prawns and indicated that the major reason the fishery had not collapsed was because this closure provided a measure of protection for most of the prawn populations.

To gain an understanding of how the fishery was being prosecuted and how this had changed as the fishery developed, the project team examined the recent Vessel Monitoring System and historical logbook location data back as far as 1975.

These data showed that the distribution of fishing effort and catch within the 3-nm inshore fishery closure were very important for the economic sustainability of the fishery even during its early development. The team found that currently about a third of the total prawn catch was coming from within the 3-nm closure zone – despite trawling in this zone being prohibited.

This illegal accessing of the inshore Gulf waters has been a source of great tension between the fishing industry and the traditional resource owners in the Gulf of Papua.

The team's analysis found that these incursions by the fishery into the 3-nm zone did not appear to substantially impact the sustainability of the prawn populations. However, the catch rates within the 3-nm zone were over 30% higher than on the adjacent fishing grounds. Thus, the economic viability of the fishery actually depended on being able to access the inshore waters with higher prawn densities.

The project has recommended that fishing operators be allowed to access the zone up to 2 nautical miles from the coast between July and November. There were fewer small prawns during this time and the fishery would not catch many early recruits to the population that move into the fishery in the first half of the year.

Another recommendation is that individual operators enter into an access agreement with the traditional resource owners before they can fish within 3 nm. This should return some economic benefits of the industrial fishery to the community and thus reduce the tension between the parties. In summary, fishing vessels may trawl the more productive inshore waters, ensuring their financial security, while remote coastal villages receive some income.

FIS/2006/133: Study to evaluate options and opportunities to improve management arrangements for sea cucumber fisheries in PNG

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of New England, Australia
Project Budget	\$59,800
Project Duration	25/09/2006 to 31/01/2007
ACIAR Research Program Manager	Mr Barney Smith

Project background and objectives

This study to evaluate options and opportunities to improve management arrangements for sea cucumber fisheries in PNG arose from the recommendations of an earlier ACIAR project.

Project outcomes

Final report not yet submitted by the Commissioned Organisation.

FST/1998/118: Planning methods for sustainable management of timber stocks in Papua New Guinea's forests

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Bureau of Rural Sciences, Australia
Project Leader	Professor Rod Keenan Phone: 03 5321 4124 Email: rkeenan@unimelb.edu.au
Project website	http://www.ffp.csiro.au/tigr/atcsmain/
Collaborating Institutions	Papua New Guinea Forest Research Institute, Papua New Guinea Southern Cross University, Australia Queensland Forest Research Institute, Australia Australian National University, Australia
Project Budget	\$842,009
Project Duration	01/07/2001 to 30/09/2005 (Project extended from 01/07/2003 to 30/09/2005)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Papua New Guinea has over 28 million hectares of tropical forests. These forests play an important role in the conservation of tropical biodiversity and in the livelihood and development of rural and forest dwelling communities. Up to 40% of PNG forests are considered exploitable for timber production with current technology.

There has been a rapid growth of forest harvesting and log export since the 1980s and this has led to major policy reforms in PNG. However, plans on how to use forest resources remain rudimentary and the implementation of policy reforms has been difficult. Consequently, there has been over-cutting of forests, depletion of resources, a heavy environmental impact, and a long-term impact on the future of forest-dependent communities.

For policy and regulatory reforms to be effective, these need to be underpinned by improved planning systems that will integrate national and regional conservation, and involve customary owners, forest companies and small-scale users of forests.

The goal of this project was to assist PNG to better manage its native forest resources through the introduction of improved technology and through the enhancement of its scientific, technical and management capacity.

The project used technology, planning experience, and management techniques developed for Australian native forests and adapted them to areas that are typical of PNG forests. Much of the methodology developed in this project could also be applied to the calculation of carbon stocks.

Project outcomes

This project resulted in increased capacity and knowledge within the PNG government for forest planning and inventory, and improved systems to analyse alternative options for timber harvesting. Key outputs included:

- A major review of forest area assessment, inventory and planning systems used in PNG.
- Re-measurement of 32 large permanent sample plots in cut-over native forests across PNG. Data from these plots have been used to assess the response of forests to harvesting and to develop new functions for a forest growth model. This information is being used to inform policy decisions on the future use of forests in PNG. The data management system for PSPs was revised and updated.

CONCLUDED PROJECTS

- Growth model analysis, which suggests that the 35-year cutting cycle in place in PNG is probably too short to allow for commercially viable future harvests if all trees greater than 50 cm DBH are cut. Longer cutting cycles, higher diameter limits for species that can reach larger sizes, leaving a proportion of current commercial trees for future harvest and reducing harvest impact will provide for more economically and ecologically sustainable timber harvesting.
- An analysis that compared timber volumes assessed in forest inventory with actual harvest volumes to determine the cause of differences between these. This kind of analysis is now being applied more widely, to develop estimates of timber resources that more closely reflect industry harvest performance and more realistic estimates of future yield and annual allowable cut.
- A revised strategic forest inventory method that will result in cheaper and more accurate inventories of future project areas.
- A simple system to integrate existing forest area, inventory and growth information. This system produces more reliable estimates of future timber yield under different harvesting scenarios for incorporation into forest planning and project documents.
- More capable and trained staff in the PNG Forest Authority, Forest Research Institute and the Department of Environment and Conservation, who are able to undertake improved analysis of forest inventory information and forest management options.

7.3 Subprogram 3: Biosecurity policy and capacity enhancement

Projects:

Active

AH/2001/054	The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific
CP/2000/044	Taro beetle management in PNG and Fiji
CP/2003/029	Management of potato late blight in Papua New Guinea
CP/2003/042	Fruit fly management in Papua New Guinea
CP/2004/064	Biological control of 'mile-a-minute' (<i>Mikania micrantha</i>) in Papua New Guinea and Fiji
CP/2005/136	(Multilateral) Mitigating the threat of banana <i>Fusarium</i> wilt: understanding the agro-ecological distribution of pathogenic forms and developing management strategies (IPGRI)
CP/2006/017	Management of <i>Eumetopina flavipes</i> : the vector of ramu stunt disease of sugarcane in Papua New Guinea
CP/2006/063	Integrated pest management for Finschhafen disorder of oil palm in Papua New Guinea

Concluded

ADP/2001/068	Technical support for regional plant genetic resources development in the Pacific
CP/1994/043	Virus indexing and DNA fingerprinting for the international movement and conservation of taro germplasm
CP/1996/091	Biological control of <i>Chromolaena odorata</i> in Indonesia, Papua New Guinea and the Philippines
CP/2006/051	Cocoa pod borer scoping study in PNG
SMCN/1998/028	Diagnosis and correction of nutritional disorders of yams

Pipeline

AH/2006/157	Improved biosecurity for animal diseases in Papua
CP/2006/114	(Multilateral) Managing cocoa pod borer in PNG through improved risk incursion management capabilities, IPM strategies and stakeholder participatory training (CABI)

AH/2001/054: The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific

Bilateral

Overseas Collaborating Countries	Fiji, Kiribati, Papua New Guinea, Tonga
Commissioned Organisation	Murdoch University, Division of Veterinary and Biomedical Sciences, Australia
Project Leader	Dr Simon Reid Phone: 08 9360 7423 Fax: 08 9310 4144 Email: s.reid@murdoch.edu.au
Collaborating Institutions	National Agriculture Quarantine and Inspection Authority, Papua New Guinea Secretariat of the Pacific Community, Fiji University of Melbourne, Australia Children's Hospital, Westmead, Australia Department of Agriculture, Fisheries and Forestry, Australia WHO/FAO/OIE Collaborating Centre for Reference & Research on Leptospirosis, Australia
Project Budget	\$555,579
Project Duration	01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr Peter Rolfe

Project background and objectives

Zoonotic diseases (diseases transmitted from animals to humans) are thought to be increasing in the South Pacific as livestock production intensifies. Most countries and territories in the South Pacific are experiencing a growing demand for animal products, as human populations increase and expectations rise for higher living standards. Greater intensification of animal production in areas with limited land resources has increased the possibility of human-animal contact, and thus the risk of zoonotic disease.

Trichinellosis, leptospirosis and angiostrongylosis are the diseases of most concern in the region. Leptospirosis infection causes production loss in livestock and is a serious public health issue, especially for owners of livestock and workers in the processing industry.

Angiostrongylus cantonensis infection is an unquantified threat to livestock health and is emerging as a serious public health problem. Trichinella infection in pigs is a barrier to livestock trade and could result in a significant loss to producers. If this organism entered Australia, it could cause severe economic losses to the Australian pork industry.

The aim of this project is to determine the extent of the problem posed by zoonotic diseases, and to develop control strategies to reduce their impact.

Project Progress

Year 5 (01/01/2006–31/12/2006)

Progress towards project milestones has been hampered by technical issues in PNG related to the emergence of avian influenza as a high priority disease, which reduced the time project staff had to devote to project activities. Longitudinal and cross-sectional surveys to determine the prevalence of *Leptospira* infection in animals in smallholder villages and to determine the dynamics of transmission on commercial cattle properties have progressed well.

This work has so far demonstrated that there is a very low prevalence of *Leptospira* infection in animals in smallholder villages associated with commercial properties. This means that the animals do not pose a risk to humans and that leptospirosis is unlikely to be a major constraint to livestock production. Samples collected from commercial properties are in the process of being tested.

CP/2003/042: Fruit fly management in Papua New Guinea*Bilateral*

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	NSW Department of Primary Industries, Australia
Project Leader	Mr Andrew Jessup Phone: 02 4348 1965 Fax: 02 4348 1910 Email: andrew.jessup@dpi.nsw.gov.au
Collaborating Institutions	National Agriculture Quarantine and Inspection Authority, Papua New Guinea National Agricultural Research Institute, Papua New Guinea University of Western Sydney, Australia Queensland University of Technology, Australia Pacific Adventist University, Papua New Guinea Fresh Produce Development Agency, Papua New Guinea
Project Budget	\$740,571
Project Duration	01/04/2006 to 31/03/2009
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Fruit flies are the major pest of horticulture in the South Pacific. They lay their eggs into fruit and vegetables where the larvae cause direct fruit damage. In PNG, where growers are generally smallholders who routinely market produce that is excess to family/village needs, fruit infestation levels routinely range above 20%. Better fruit fly management is an ACIAR-listed PNG priority.

This project is a continuation of the previous ACIAR project CS2/1996/225, *Identification, Biology, Management and Quarantine Systems for Fruit Flies in PNG*. The previous project identified PNG's pest fruit flies and susceptible crops, and this new project is now packaging the outputs of the earlier project, devising practical actions for fruit fly management in both PNG and Australia.

Research for this project is a true collaborative effort between Australia and PNG. On the Australian side scientists are developing new generation protein baiting and mineral spray oil application technologies for extension to both Australia and PNG.

The PNG team is developing the trapping, cultural and physical aspects of fruit fly control, for extension to PNG and also for use in Australia. PNG trials are being conducted as formal on-station and on-farm trials, with farmer participation and on-farm demonstrations.

Building on methods and contacts established in CS2/1996/225, this project is using a farmer participatory technology development (PTD) approach, focusing specifically on:

- confirming status/importance of fruit flies in selected crop production areas, by analysing data from the earlier project to identify temporal and spatial distribution of PNG pest fruit flies for each area/crop/season combination targeted in this project;
- trialling and implementing various technologies for fruit fly control;
- enhancing fruit management skills of extension workers and farmers.

Project Progress**Year 1 (01/04/2006–31/03/2007)**

Project commencement: The project commenced with the first face-to-face project workshop held in Port Moresby on 30 June 2006. Discussions were held between the PNG and Australian collaborators and personnel from ACIAR on which districts (and which sites within these districts) in PNG we would use to carry out experiments, which crops to study and which PNG agencies and personnel were available to participate in this project.

Project workshops and training: In addition to the PNG/Australia workshop mentioned above there have been several more conducted around the four districts in PNG at which various aspects of the project will be studied. NARI staff from Port Moresby travelled to the experimental sites/agencies in the four districts to demonstrate how to collect fruit, rear fruit flies and identify fruit flies for the project.

Experimental design: On a second trip to PNG Andrew Jessup and Andrew Beattie travelled to the four districts with district collaborators to view potential farms and orchards on which to carry out experiments. Experimental designs were worked out to suit each site/crop/district/fruit fly species combination with a view to making each design as similar as possible to those in all other districts, to allow for direct comparisons.

Farmer survey: Anna Kawi set up a Farmer Questionnaire on the knowledge of fruit flies and their impact on horticultural production. The survey has gone out to officers in all districts. The questionnaire is designed to be carried out at the beginning of the project (already achieved), during the middle and towards the end, to gauge changes in grower knowledge/perception of fruit flies.

Fruit survey: Staff in each district are collecting fruit from identified farms within their district and rearing out flies which are counted and identified. We will soon have comprehensive lists of fly species, crops attacked, the severity of infestation, time of year that crops are attacked as well as the economic impact of infestations on the grower.

Trap survey: Staff from each district have set up and placed out fruit fly traps capable of trapping the majority of pest fruit fly species. Flies are periodically collected, counted and identified to give a list of fruit fly species, numbers trapped, time of year and district.

PNG experiments: Experiments have commenced on bagging (a physical fruit fly exclusion method) individual guava fruit on tree, netting entire capsicum plants (another physical fruit fly barrier) and fruit fly baits in comparison with insecticides. More experiments are planned once experimental material is sourced in Australia and shipped to PNG.

Australian experiments: Experiments have commenced in Australia to design a physical system for the disposal of fallen/damaged/infested fruit in-field whilst allowing the survival and dispersal of fruit fly parasitoids (a form of biological control of fruit flies). Also tests on new female fruit fly lures and traps have commenced.

Analysis: Data from previous ACIAR projects on PNG are being analysed by John Allwright Fellows at the Queensland University of Technology.

CP/2005/136: Mitigating the threat of banana *Fusarium* wilt: understanding the agroecological distribution of pathogenic forms and developing disease management strategies

Multilateral

Overseas Collaborating Countries
Commissioned Organisation
Project Leader

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Collaborating Institutions

Queensland Department of Primary Industries and Fisheries, Australia
 Indonesian Fruit Research Institute, Indonesia
 National Agricultural Research Institute, Papua New Guinea
 National Agriculture Quarantine and Inspection Authority, Papua New Guinea
 Agency for Agricultural Quarantine, Indonesia

Project Budget

\$445,274

Project Duration

01/06/2006 to 31/05/2009

ACIAR Research Program Manager

Dr T K Lim

Project background and objectives

Fusarium wilt disease caused by *Fusarium oxysporum* f. sp. *ubense* (*Foc*), one of the most devastating plant diseases, is a major concern for banana-producing countries. The damage potential of the disease is exemplified by the devastating outbreaks that occurred in Latin America in the 1950s, which destroyed whole plantations and led to the disappearance of the Gros Michel cultivar from the commercial dessert banana industry.

Foc is conventionally classified into four pathogenic forms known as 'Races'. Race 1, which destroyed the Gros Michel plantations, also attacks many local cultivars in Asia; Race 2 affects specific cooking bananas. The particularly virulent 'Tropical' Race 4 affects a wide range of cultivars including Cavendish, and has caused substantial production losses for commercial and subsistence farmers in Indonesia, Taiwan, Malaysia and the Northern Territory of Australia. *Foc* is also classified into vegetative compatibility groups (VCGs) - 21 clonal lines of VCG are known to exist. Recently, severe infections were reported on Cavendish plantations in China and the Philippines.

The variation in pathogenicity within the conventional races highlights the need for more precise characterisation of variability based on VCGs, and a better understanding of the relationship between pathogenicity and *Musa* (banana and plantain) diversity.

Foc cannot be effectively managed with fungicides and the disease remains over a long period in the soil. The early and accurate diagnosis of the disease, prevention of its spread and the deployment of management strategies are, therefore, of utmost importance. The impact of the disease has prompted the Banana Asia Pacific Network, BAPNET, to call for support for increased research into pathogenic variability, host-resistance and sustainable disease management methods to alleviate the losses caused by this disease.

The objective of this project is to carry out a comprehensive survey and characterisation of *Foc* pathogenic forms and to develop national strategies for disease exclusion, containment and management, identifying a package of management tools through participatory approaches and exploiting existing networks to enable 'fast-track' adoption of effective measures.

Project Progress

Year 1 (01/06/2006–31/05/2007)

The project inception meeting and workshop was held on 22–26 August 2006 at Bukit Tinggi, West Sumatra, Indonesia, hosted by ITFRURI. Seventeen participants from ITFRI, Bioversity–Philippines, QDPI&F and ACIAR attended. During the meeting, the project's objectives were reviewed and its work plan developed.

Survey, collection and characterisation

A training-workshop on soil health indicators and survey methodology was conducted at ITFRURI in Solok, West Sumatra on 6–10 November 2006. Forty-two staff of ITFRURI participated. The training was organised and facilitated by Tony Pattison of QDPI&F. Researchers were trained to operate the soil health indicator kit as well as to interpret the results. A training manual was produced and circulated.

Survey and collecting missions of *Foc*-infected plants were conducted from December 2006 to April 2007 by project staff of ITFRURI, Bioversity - Philippines and QDPI&F. The missions covered eight major banana-producing regions/provinces of Indonesia: Aceh, West Java, West, Central and South Kalimantan, North and Southeast Sulawesi and Papua. Eighty-five plant samples infected with *Fusarium* wilt (caused by the pathogen *Fusarium oxysporum* f. sp. *cubense* or *Foc*) were collected from the survey sites.

Based on initial survey analyses, 16 host varieties were infected with *Fusarium* wilt across the surveyed locations. The most common varieties infected were 'Barangan' (AAA), 'Raja Siem' (ABB), 'Kepok' (BBB) and 'Ambon Putih' (AAA). Aside from *Fusarium* wilt, blood disease and Banana Bunchy Top Virus (BBTV) disease were also observed. The samples were brought to ITFRURI for processing and sending to QDPI&F.

An important output of the survey and collecting missions was the collection of 11 new banana accessions consisting of wild, diploid, triploid and tetraploid plants. These materials are now maintained at the genebank of ITFRURI, the designated National Repository and Multiplication Center of Indonesia and will, eventually be taxonomically characterised.

A total of 111 pure isolate-*Foc* samples from ITFRURI were sent to QDPI&F for VCG and DNA characterisation. The first batch was composed of 60 purified isolates while the second consisted of 51. Twenty-four isolates of the first batch were analysed for volatile production and VCG characterisation.

Most samples were positive for VCG 1213/16, the VCG of *Foc* Tropical Race 4 (TR4). DNA from 50 of the 60 samples in the first batch were extracted and quantified, while the rest were either contaminated or returned. The second batch of samples is being prepared for characterisation. All samples are to be freeze-dried for long-term conservation.

Virulence-host resistance study

Preliminary preparations have begun. Twenty-five accessions of diploid, triploid, and tetraploid wild and cultivated varieties were chosen for this study. The plant materials are currently being propagated *in vitro* at ITFRURI. The *Fusarium* wilt inoculation technique/protocol was validated and optimised at ITFRURI from October to December 2006 using the 'Barangan'/'Lakatan' variety. VCG 01216 was used in the preliminary inoculation test.

On-farm disease management demo-trials of disease management strategies

Project staff of Bioversity, QDPI&F and ITFRURI conducted participatory planning workshops with farmers and local extension agents in Kedondong, Lampung, Sumatra, and in Dampit, Malang, East Java on 27 May–2 June 2007.

About 25 farmers participated in each site. The workshops included an initial assessment of farmers' practices in banana disease management and production systems. Consequently, planting materials and disease management tactics (i.e. biocontrol agents) for the demo plots are being readied by ITFRURI in preparation for the start of the field trials in October or November 2007.

To complement this activity, the project coordinator met with the provincial officers of the Balai Pengkajian Teknologi Pertanian or BPTP (Assessment Institute for Agricultural Technology) in Lampung and Malang.

ACTIVE PROJECTS

An agreement was reached wherein BPTP extension staff would provide local technical support and supervision to the trials. Additionally, the project team visited a private banana commercial plantation (PT Nusantara Tropical Fruits, or NTF) in Lampung on 28 May 2007. Team members discussed with NTF the possibility that they would participate in field trials to evaluate the project's proposed disease management strategies under commercial Cavendish plantation conditions where Foc Tropical Race 4 is a serious problem. This gives the project a broader scope involving both farmers' fields and a commercial plantation.

CP/2006/017: Management of *Eumetopina flavipes*: the vector of ramu stunt disease of sugarcane in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Bureau of Sugar Experiment Stations, Australia
Project Leader	Dr Robert Magarey Phone: 07 4068 1488 Fax: 07 4068 1907 Email: rmagarey@bses.org.au
Collaborating Institutions	James Cook University, Australia Ramu Sugar Limited, Papua New Guinea
Project Budget	\$149,641
Project Duration	01/06/2006 to 31/05/2008
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The sugarcane disease Ramu stunt is a devastating and quarantinable disease spread by the planthopper, *Eumetopina flavipes* Muir, and has caused losses of up to 60% on sugarcane in PNG. The planthopper is also present in some areas in northern Australia but the disease has not yet established.

The aims of this research are to develop an integrated management program for the planthopper and to enhance the protection of the Australian sugarcane industry. This will be developed through surveys, control trials, establishment of quarantine guidelines and cane grower education.

Project Progress

Annual report not yet submitted by the Commissioned Organisation.

CP/2006/063: Integrated pest management for Finschhafen disorder of oil palm in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	Charles Sturt University, School of Rural Management, Australia
Project Leader	Dr Geoff Gurr Phone: 02 6365 7551 Fax: 02 6365 7590 Email: ggurr@csu.edu.au
Collaborating Institutions	NSW Department of Primary Industries, Orange Agricultural Institute, Australia PNG Oil Palm Research Association Inc, Dami Research Station, Papua New Guinea
Project Budget	\$399,950
Project Duration	01/03/2007 to 28/02/2010
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

Finschhafen disorder (FD), which leads to severe damage of palm fronds, was first observed in 1960 on coconut palms near Finschhafen in Morobe Province PNG. FD now threatens the production of oil palm. Limited research to date suggests the disorder may be a direct consequence of feeding by a planthopper (*Zophiuma lobulata*).

This project will provide a foundation of biological knowledge to establish the causes of FD (it may be a micro-organism carried by the planthopper) and formulate appropriate responses. New information on the exact cause and viable control methods for FD will minimise the risk of further crop losses.

Project Progress

First progress report due in 2008.

ADP/2001/068: Technical support for regional plant genetic resources development in the Pacific

Multilateral

Overseas Collaborating Countries	Fiji, Kiribati, Malaysia, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
Commissioned Organisation	Bioversity International, Malaysia
Project Leader	Dr V. Ramanatha Rao Phone: +60 3 89423891 Fax: +60 3 89487655 Email: v.rao@cgiar.org
Collaborating Institutions	Secretariat of the Pacific Community, Fiji
Project Budget	\$933,797
Project Duration	01/01/2002 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Simon Hearn

Project background and objectives

The unique and important diversity maintained in the perennial crop-based production systems of Pacific Island countries has in recent years become better recognised. In the context of agricultural plant genetic resources (PGR) conservation and use, scientists have undertaken some collecting, conservation and improvement of PGR (e.g. roots and tubers, bananas, coconuts and breadfruit) in the region.

Associated initiatives include the establishment of the Regional Germplasm Centre (RGC) at the Secretariat of the Pacific Community (SPC) together with activities funded by the European Union (the EU-funded Pacific Regional Agricultural Programme (PRAP)), INIBAP (for bananas and plantains), Australia's Department of Agriculture, Fisheries and Forestry (DAFF) through SPC, and COGENT (for coconuts).

Examples of PGR activities in the region include: the AusAID-funded TaroGen project for the improvement, conservation and utilisation of taro genetic resources; the EU-funded South Pacific Yam Network (SPYN) for collecting and conservation of *Dioscorea alata*; COGENT activities focusing on the collecting of coconut populations from Pacific Island countries and their establishment in the PNG International Coconut Genebank; further breadfruit characterisation; and distribution of INIBAP banana lines resistant to Black Leaf Streak virus.

Despite these investments, progress had been confined to a few crops in a limited number of countries. Thus in April 1999 ACIAR supported a workshop in Lae, PNG to develop a framework for PGR conservation, management and use in Pacific agriculture.

The workshop led to a PGR Working Group facilitated by SPC, with members drawn from PNG and Fiji. The working group developed the regional plant genetic resources framework for the Pacific, which was approved by the Permanent Heads of Agricultural and Livestock Services (PHALPS) during its meeting in Fiji in early 2001.

This project developed complementary conservation strategies (CCSs) for agricultural crops of importance in the Pacific Region as a basis for sustainable plant genetic resource (PGR) conservation.

Major objectives were:

1. Ensure effective coordination of PGR activities at regional level in the Pacific
2. Develop and implement strategies for the effective conservation and use of PGR for food and agriculture in the Pacific (including neglected and underutilised species)
3. Increase capacity in PGR conservation and use in the Pacific.

Project outcomes

ACIAR support for IPGRI and SPC helped the establishment of the Pacific Agricultural Plant Genetic Resources Network (PAPGREN) in 2001. Members of the network are from Cook Islands, Fiji, Kiribati, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. Its task is to develop management strategies for agricultural PGR in the Pacific, and promote the safe exchange of germplasm within and outside the region.

A major output of the PAPGREN annual meeting in Vanuatu in October 2005 was an agreement on the main points of a regional strategy for the Global Crop Diversity Trust and a revised document was submitted based on comments and suggestions received in early 2006. It was presented to the 2nd Heads of Agriculture and Forestry Services meeting in Sept. 2006. The Trust now considers the Pacific regional strategy completed and has posted it on its website.

At the 2005 annual meeting, the network members were briefed on developments in reaching a Standard Materials Transfer Agreement (SMTA) for the Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

A follow-up workshop in May 2006, with complementary funding from Australia's DAFF, succeeded in further raising regional awareness of the ITPGRFA. The 2006 annual PAPGREN meeting discussed all the above issues as well as a new project funded by NZAID which will continue many of the initiatives begun by the present project.

In developing and implementing strategies for the effective conservation and use of PGR for food and agriculture in the Pacific (including neglected and underutilised species) (Objective 2), PAPGREN meetings in 2004 and 2005 agreed on the elements of a regional strategy for *ex situ* conservation. This strategy is based on complementarity of approaches (field genebanks, *in vitro* and cryopreservation), adequate duplication, and effective collaboration among all stakeholders within the region and beyond.

It includes elements of the strategy for taro and breadfruit developed by TaroGen and PAPGREN, and builds on outcomes of this project's precursors. Pacific regional strategies for banana and coconut have also been developed for the Trust with substantial input from the Regional Germplasm Centre and PGR Advisers in consultation with national program focal points.

The regional strategy has now been presented to Pacific Heads of Agriculture and Forestry (HOAFs) and accepted by the Trust. It will guide the Trust's allocation of funds to the region in the future.

To complement these strategies for staple crops, the 2006 annual PAPGREN meeting agreed to a regional strategy for the development of neglected and underutilised crops based on interventions. The subregional strategy developed for the Trust contains several elements on a number of underutilised crops of the Pacific.

In efforts to increase capacity in PGR conservation and use in the Pacific (Objective 3) the ACIAR-supported PGR Adviser provided training and helped in increasing awareness on PGR issues in the subregion. Major emphasis was given in early 2006 to the policy issues arising from the ITPGRFA negotiations that culminated in the workshop funded by DAFF.

In 2006 considerable time and effort went into building awareness of the ITPGRFA (and into the associated area of the Trust regional and crop strategies) as these are important for promoting an enabling environment (both policy and financial) in the region to fully support PGR activities. The annual PAPGREN meeting in November 2006 was the last to be organised by the PGR Adviser.

CP/1994/043: Virus indexing and DNA fingerprinting for the international movement and conservation of taro germplasm

Bilateral

**Overseas Collaborating Countries
Commissioned Organisation**

Fiji, Papua New Guinea, Samoa
Queensland University of Technology, Centre of Molecular
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Project Leader

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Collaborating Institutions

Secretariat of the Pacific Community, Fiji
Ministry of Agriculture, Forests, Fisheries and Meteorology,
Samoa
University of Queensland, Australia
University of Technology, Papua New Guinea
University of the South Pacific, Samoa
National Agricultural Research Institute, Papua New Guinea

Project Budget

\$1,576,307

Project Duration

01/07/1998 to 30/06/2007
(Project extended from 01/07/2006 to 30/06/2007)

ACIAR Research Program Manager

Dr T K Lim

Project background and objectives

Taro is widely grown in Papua New Guinea (PNG) and many other Pacific Island countries. It also plays an important cultural role. The roots are a source of carbohydrate, and the foliage is also eaten. It is cultivated mainly in gardens for local use, but there is also a domestic and export market.

Over the last 20 years there has been a gradual decline in the production of taro because of the effects of pests and diseases. Taro leaf blight, caused by a fungus, is the most serious and widespread disease of the plant in Pacific countries. It has long been present in Micronesia, Papua New Guinea and the Solomon Islands, but in 1993 it spread to American Samoa and Samoa with devastating consequences. Many growers have since abandoned taro cultivation in these countries, causing major social and economic problems. Export earnings in Samoa fell from 9.5 million Tala to 158,000 Tala in just one year after the arrival of the blight.

The genetic diversity of taro is poorly known, but some described varieties are resistant to the fungus. In 1993, a breeding program started up in PNG to develop these varieties but the taro germplasm cannot be moved between countries because of the presence of a lethal virus disease known as alomae. It is now important to characterise this disease (which seems to be associated with the presence of two viruses together) and develop reliable tests for the presence of both viruses within taro germplasm. This should then allow free movement of germplasm and thereby help in combating leaf blight and in developing other features of the plant.

Increased knowledge of alomae will be helpful of itself because this disease is now the main constraint on taro production in PNG and the Solomons. Elsewhere it seems that the two viruses do not occur together; when only one virus is present, disease symptoms are much milder. Characterising the virus diseases of taro, a Pacific Island staple crop, is under way as the first step to developing sensitive specific tests for each virus. The aim of the project is to characterise the virus diseases of taro, a Pacific Island staple crop, and to develop sensitive specific tests for each virus.

Project outcomes

Characterisation of all taro viruses and development of diagnostics

(a) Taro reovirus (TaRV): Investigation of the sequence variability in the genome of isolates from PNG, Solomon Islands, New Caledonia and Vanuatu TaRV enabled researchers to gather sufficient data to develop a specific PCR-based diagnostic assay for this virus.

(b) Taro vein chlorosis virus (TaVCV): The researchers cloned and sequenced the entire genome of a Fijian TaVCV isolate. A diagnostic PCR test has now been developed for this virus based on a 220 nt region of the L-gene.

(c) Colocasia bobone disease virus (CBDV): The researchers cloned and sequenced approximately half (~5000 nt) of a PNG isolate of CBDV. A PCR-based diagnostic has been developed based on a region of 'gene 3'.

(d) TaBV-like sequence: Preliminary characterisation and analysis studies indicated that the TaBV-like sequences present in taro are integrated sequences. Further work is needed to determine whether these sequences can be activated and cause disease.

Thus the characterisation of TaRV and the two rhabdoviruses has enabled the subsequent development of sensitive diagnostic tests for these viruses. As such, diagnostics tests have now been developed for all known viruses infecting taro. The availability of a suite of taro virus diagnostics will now enable taro germplasm to be virus-indexed, thus facilitating safe international movement of taro germplasm.

Virus Survey

Surveys were conducted in Vanuatu, Samoa, American Samoa, Fiji, PNG, Solomon Islands and New Caledonia. Samples were also provided from Micronesia and the Cook Islands. These samples have been indexed for all known viruses using the newly developed molecular-based diagnostic tests. The virus surveys, conducted in countries wishing to share germplasm under the TaroGen project, provided updated information on virus distribution. These data, combined with the results from virus-indexing from the TaroGen germplasm collection, allowed countries to make informed decisions on the importation of taro germplasm.

Virus indexing of TaroGen taro germplasm collection held at SPC, Fiji

Approximately 450 tissue-cultured taro lines held in the germplasm collection at SPC have been sent to Brisbane for growing in AQIS-greenhouses and indexing. Of these, 159 have been indexed for each of the taro viruses according to an internationally-recommended schedule. Safe international transfer of indexed taro germplasm will therefore now be possible, allowing countries access to a diverse pool of germplasm with disease resistance and other agronomic qualities.

DNA fingerprinting of national taro collections

Taro collections from nine Pacific Island Countries were DNA fingerprinted using radiolabelled SSR (Simple Sequence Repeat) markers. These markers were developed as a resource for taro research both within the region and internationally. Taro collections were made in most cases as part of the TaroGen germplasm collection. Entire collections from Fiji, Samoa, Tonga, Niue, Palau, Cook Islands were fingerprinted. A 20% sample of the country collection was fingerprinted from Papua New Guinea, Solomon Islands, Vanuatu and New Caledonia, as these collections were too large to fingerprint all accessions.

There were some delays in receiving collections from some countries. Civil unrest, disease and cyclones prevented the Solomons' collection from being received until 2002. Even then, this was not a representative country collection, rather it was separate samples from three provinces: Choiseul, Malaita and Temotu. The Guadalcanal collection was lost to virus and other diseases before samples were taken. Researchers received two collections representing Samoa, one from the Botanic Gardens of the University of Hawaii, and one from MAFF in Samoa. In the case of Solomon Islands, Fiji and the Polynesian countries, collections were received from the Regional Germplasm Collection at SPC as tissue cultures. In other cases, they received leaf samples directly from the country.

CONCLUDED PROJECTS

From the overall collection of 2206 accessions, 527 were DNA fingerprinted with SSR markers, which were used to assess within- and between-country taro genetic diversity, and to identify a DNA fingerprint of accessions. It was evident that most (if not all) of the genetic diversity within South Pacific taros could be sampled from PNG and Solomon Islands.

Interestingly, two SSR alleles were found only in the Solomons. This was somewhat unexpected, and is a tantalising hint at a localised adaptation or separate introduction within taros in the Solomons. It is worth noting that none of the PNG taros fingerprinted were from Bougainville, which is geographically closer to the Solomons than it is to other islands of PNG. There were some quite diverse taros in the small sample of accessions from Palau, probably representing some more Asian taro types. Evidence from our study and that of the EU-TANSAO study suggest that there are two 'Centres of Diversity', one in PNG/Solomons and the other in Indonesia/Malaysia.

Rationalisation of taro germplasm to form a core collection

Based on DNA fingerprints, researchers selected a core collection for each country. The aim of the core collection is to reduce the size of the collection to about 10% of the total accessions while attempting to maintain at least 85% of the genetic diversity available. The core collection can then be conserved more easily and utilised more effectively, as these accessions can be more extensively characterised (for example for pest and disease resistances, corm attributes and response to abiotic stresses).

Once core collections were selected for each country, the combined all-country data set was analysed to improve the level of overall genetic variation for the region. The core collection is stored as *in vitro* tissue cultures, primarily at the Regional Germplasm Collection (RGC) at SPC in Suva, Fiji. Duplicate collections are kept at USP Alafua Campus, Samoa, with plans to maintain a sample at the International Potato Centre (CIP) in Peru, and negotiations are under way to maintain a duplicate collection in PNG.

Regional expertise

This has been boosted with the training at Queensland University of Technology of Mr Macquin Maino from University of Technology, Lae, PNG, who completed his Master of Science Degree within the Centre for Molecular Biotechnology. He has returned to UniTech, Lae, to play a key role in the continued development of the Agricultural Biotechnology Centre, and training of new scientists. Also at QUT, and Mr Apaitia Macanawai from USP (Samoa) who completed his Master of Agriculture Degree. Mr Macanawai investigated the epidemiology of taro small bacilliform virus and examined alternative hosts, vectors and seed transmission.

At University of Queensland Mr Tom Okpul from NARI, Bubia spent 3 months in 2000 learning the techniques of DNA fingerprinting. He applied these techniques to a diverse set of germplasm from the NARI breeding program. He has since moved to Vudal University in Rabaul, where he has instigated taro breeding. Also at UQ Mr Robert Plak Pawilnga from Unitech, Lae visited for 2 weeks in 2001 and learnt techniques involved in database maintenance and analysis of DNA fingerprint data. He returned in 2003 where he is currently completing his Masters of Agricultural Studies. His research is focused on tissue culture and genetic transformation of taro.

A virus diagnostics workshop held at USP provided both theoretical and hand-on training in plant virus characterisation and diagnosis, using taro viruses as an example. SPC has been proactive in the development of an in-house virus indexing capacity in Fiji – this workshop provided both technology transfer and an opportunity to discuss issues such as infrastructure, equipment and logistics.

CP/1996/091: Biological control of *Chromolaena odorata* in Indonesia, Papua New Guinea and the Philippines

Bilateral

Overseas Collaborating Countries
Commissioned Organisation
Project Leader

Indonesia, Papua New Guinea, Philippines
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Collaborating Institutions

Universitas Nusa Cendana, Indonesia
 SEAMEO Regional Centre for Tropical Biology, Indonesia
 Department of Agriculture and Livestock, Papua New Guinea
 Parks and Wildlife Commission of the Northern Territory, Australia
 Gadjah Mada University, Indonesia
 Philippine Coconut Authority, Philippines
 Indonesian Oil Palm Research Institute, Indonesia
 Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, Indonesia
 Oil Palm Research Association, Papua New Guinea
 \$1,055,012
 01/07/1997 to 31/03/2007
 (Project extended from 01/07/2000 to 31/03/2007)
 Dr T K Lim

Project Budget
Project Duration

ACIAR Research Program Manager

Project background and objectives

Siam weed is a serious weed of tropical pastures and a threat to national parks and other biodiversity conservation areas. It is a prolific seed-producer and is usually toxic to livestock.

It has quickly spread from its original home in the West Indies to large areas of the wet tropics of Africa and Asia. It reached Timor by the mid-1970s and is now present in parts of Irian Jaya, New Britain and possibly the Solomon Islands. Siam weed is now considered the major weed threat to Australia. An infestation was discovered in Tully, Queensland, in 1994 and is now being eradicated with herbicides.

There are many natural enemies of this weed and biological control has long been touted as an option. By 1992, only two agents had been tried – a seed-eating weevil (*Apion brunneonigrum*) and a leaf-eating moth (*Pareuchaetes pseudoinsulata*), which were both tried in South Africa.

ACIAR project CS2/91/10 released the moth into oil palm and pastoral areas in Java, Sumatra and Timor. The moth successfully established in several areas in Sumatra, where there is now

effective control of the weed. However, the agent did not persist in Java or Timor.

Project CS2/91/10 also introduced a new control agent, the stem-galling fly *Procecidochares connexa*, from South America, which had not been tried or host-tested anywhere else in the world. The first releases were made in Indonesia in July 1995; it was also intended for release in the Philippines but government permission was not granted during the lifetime of the project. However, permission came through in February 1997, so this agent will be released in the current project.

The aim of this project was to enhance the biological control of Siam weed (*Chromolaena odorata*) in Indonesia, Papua New Guinea and the Philippines. The work continued that begun in a previous ACIAR project (CS2/91/10), which released control agents in Indonesia. The current project intends to carry out further releases, conduct field monitoring of their effectiveness and introduce additional control agents.

Project outcomes

This project was active from 1997 to 2007. During that time attempts were made at a multitude of sites in Indonesia and PNG to establish different potential control agents and monitor their effectiveness. No satisfactory outcomes were achieved in Philippines where, although a permit was eventually granted to test the gallfly, no permit could be obtained for its release, so further efforts with biocontrol were terminated.

In the period 1997–2001 the project achieved successful control of chromolaena in North Sumatra and increasing control in West Java and other areas. In estate crops such as rubber, oil palm, or coconut, there is a significant economic impact in terms of reduced herbicide use and reduced slashing rounds in the establishment phase of plantations.

However, the real economic impact is where crops are combined with livestock, and the cattle fed on plants growing in the fallow or off-season land, either by direct grazing or by cut-and-carry methods. Chromolaena is poisonous to cattle and is not grazed, but out-competes and replaces grasses and fodder legumes. Thus land invaded by the weed is not available for livestock. This has a very significant impact, especially in the eastern islands where livestock raising is an important part of the local economy. In the absence of chromolaena, other invasive weeds such as lantana may take over, but these can be controlled more easily as they are less aggressive, particularly where fire is used.

In much of Indonesia and Papua New Guinea, chromolaena was not found to be a significant environmental problem, as it is only invasive in cleared or logged forest. However, where these forests were being preserved as reserves, the invasion of chromolaena along tracks and in clearings worsened the degradation and loss of natural understorey caused by logging and other human activities. Control by the gallfly allowed the natural vegetation to compete.

In natural grasslands such as in Timor and other eastern islands, the environmental impact of chromolaena was much more severe. These grasslands were already degraded through over-grazing, but chromolaena will invade even intact savannahs wherever the rainfall is adequate and completely replace the grass.

This has severely impacted on the native vegetation and wildlife as well as destroying the livestock industry. In the period 1997–2001 control by the gallfly was not yet adequate in the eastern islands, but the degree of control increased each year and seed production and seedling growth diminished greatly.

For Australia, the impact was two-fold. First, reduced seed production in the eastern islands of Indonesia and in PNG would reduce the risk of seed being transported to Australia. The second positive outcome was that, should a large infestation of chromolaena be discovered in Australia such that eradication is not practicable, the gallfly would be immediately available for release to provide immediate biocontrol.

The gallfly proved a great success in all countries in which it was released. It has the capacity to locate and kill single plants and would be a worthwhile agent in any country where chromolaena is a problem.

For the period 2002–05 chromolaena was reported at about 500 sites in 13 lowland provinces of PNG. The gallfly was released in all provinces and its presence confirmed at about 400 sites, with about 60 unconfirmed sites. Control of chromolaena was reported at various sites in five provinces, namely Bougainville, Sandaun, New Ireland, and East and West New Britain. The gallfly should be able to spread naturally to most of the remaining sites. The moth *Pareuchaetes pseudoinsulata* was released in nine provinces but established in only one province, Morobe and is seasonally present at 20 sites.

Field monitoring and observations suggested that the gallfly performs best in shaded or semi-shaded areas, where there is high moisture or rainfall. In dry areas such as the Markham Valley in Morobe and open and exposed areas in West New Britain, the gallfly was slow to build up into damaging populations and chromolaena was not under control, despite its presence for over 5 years. *P. pseudoinsulata* appeared to prefer drier areas such as the Markham Valley, but given the level of effort required to achieve establishment, this agent is only recommended for release in exceptional circumstances.

CONCLUDED PROJECTS

A new agent, *Calycomyza eupatorivora*, was imported during this period, but there were problems with its rearing and release and it failed to establish at any site. This agent was easy to rear and establish in South Africa in Durban, where it quickly spread. However, it is possible that the areas in PNG are too hot for the insect. The project team concluded that this insect is more suited to cooler countries or regions.

In areas where the agents are less effective, land managers will still need to implement some other control measures. However, the time and cost involved should reduce in the presence of the agents.

In PNG the project involved numerous staff from the National Agricultural Research Institute from several regions. In addition, project officers collaborated with staff from government and commercial institutions. This co-operation between the organisations has helped with the success of this project, with regional officers helping to spread the agents around their districts.

A 3-day workshop on the biocontrol of chromolaena was conducted in Lae in 2003. The workshop covered aspects such as biological control of weeds, weed identification, biocontrol agents, host specificity and field release and monitoring of biocontrol agents.

As a result of this collaboration, regional officers became more aware of other weeds and took more interest in other projects. As an example, researchers from the Cocoa and Coconut Institute and the Oil Palm Research Association are involved in the ACIAR-funded biocontrol of mikania.

CP/2006/051: Cocoa pod borer scoping study in PNG

Multilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	CABI
Project Leader	Dr Wai Hong Loke
	Phone: 603 89432921
	Fax: 603 89426490
	Email: loke@cabi.org
Project Budget	\$65,000
Project Duration	01/06/2006 to 31/10/2006
ACIAR Research Program Manager	Dr T K Lim

Project background and objectives

The Asian cocoa pod borer (CPB), *Conopomorpha cramerella*, is a devastating moth pest of cocoa and the most serious constraint to cocoa production in Southeast Asia's cocoa-growing countries. Incursion of this pest into PNG was detected at Keravat, East New Britain Province (ENBP) in March 2006, with severe damage observed (90 to 100%) in some areas around the Lowlands Agricultural Experiment Station (LAES) and Kareeba Plantation. Cocoa production in PNG is an important activity (economically, socially and environmentally) and a prime pillar of the national economy. There have been both successes and failures in eradication of CPB pest incursions. Experience in the Philippines, Malaysia and Indonesia highlights that total and permanent eradication is very difficult to achieve.

CABI personnel have relevant technical expertise and a long, historical and significant track record of managing agricultural invasive alien species (IAS) such as the CPB in cocoa. A CABI team was engaged to visit PNG to assist and further build upon the initial efforts to ascertain potential for eradication and plan future contingency/management programs.

Project outcomes

The CABI team visited PNG from 7 to 21 August 2006 to support the management of the cocoa pod borer incursion. The team worked closely with PNG agencies, ACIAR, CCI, NAQIA, NARI and others. At the NARI National Agriculture Entomology Collection Centre records were found that substantiated reports of the presence of CPB in PNG from the 1940s to the 1960s. The reason why CPB was not subsequently reported until 2006 remains unclear.

CPB was confirmed in cocoa of ENBP on 29 March 2006 and West Sepik in June. Eradication operations were carried out over a 2000-ha zone of cocoa at ENBP, with follow up in West Sepik. Eradication procedures at ENBP were deemed exemplary, with inputs generally equalling if not exceeding those practised in similar efforts of other countries.

There were, however great contrasts between conditions at ENBP and West Sepik (which suffered from poor access and communications, isolation, discontinuous locations and relative neglect of cocoa plantings) and it will be a major challenge to fulfil all that has been planned for West Sepik.

In the light of the overall impressions gained through the visit, prognoses for eradication of CPB depend on three scenarios under which cocoa are grown. Prospects for eradication diminish down the continuum from Scenario 1 to 3. In a best-case situation, the CPB would be eradicated in the ENBP while incursions in West Sepik would be contained.

This could lead eventually to the division of PNG into CPB-free zones, with strict inter- and intra-country quarantine measures to maintain the status of such zones. The worst-case scenario would be the failure to eradicate the CPB, leaving the cocoa enterprises of the nation trying to live with and manage the pest. Arrival at the latter situation is strongly indicated should the CPB re-emerge at the Scenario 1 infestations, despite the current intense eradication inputs.

CONCLUDED PROJECTS

The CABI team recommended immediate implementation of follow-up actions outlined in the report by the Emergency Response Unit at ENBP.

Of these, the following were emphasised:

1. Maintenance of CPB awareness and education
2. Institution of a systematic and standardised nation-wide surveillance program
3. Surveillance must be multi-tactical in nature.

At West Sepik, urgent requirements were:

1. Improve accessibility and communications for emergency response work
2. Increase awareness of the pest among farmers and the general populace of the Province
3. Implement multi-tactical surveillance for the pest
4. Set up quarantine road blocks.

Although it is only logical for authorities to attempt to eradicate CPB incursions in PNG, the possibility of this being fully realised in the long term is unlikely. It would thus be prudent to make plans in PNG for managing the pest in its cocoa. Recommended priorities for the management of CPB infestations were:

1. Maintenance pruning, canopy reduction and height control of cocoa
2. Regular and systematic monitoring
3. Frequent and complete harvesting
4. Sanitation
5. Target pod spraying
6. Use of tolerant/resistant planting materials.

There is a concern that even implementing the above basic inputs would not be feasible on the more remote or highly subsistence-level farms. However inputs (1), (3) and (4) alone could bring about meaningful suppression of CPB damage. Effective farmer training is needed through participatory activities, and this can only be implemented after training of extension workers.

The following directions for research were recommended:

1. Use tolerant/resistant planting materials
2. Refine CPB monitoring methods
3. Prospect for biological control agents
4. Screen for insecticides and pesticide application technology
5. Install demonstration plots.

More basic and long-term research of benefit to managing CPB in PNG includes identification of alternative host plants of CPB, molecular determination of CPB biotypes or races together with cross-hybridisation and cross-infestation studies, classical biological control by importation and mass production of parasitoids, development of biopesticides, and investigations on other semiochemicals besides pheromones.

SMCN/1998/028: Diagnosis and correction of nutritional disorders of yams

Bilateral

Overseas Collaborating Countries Commissioned Organisation	Papua New Guinea, Tonga, Vanuatu University of Queensland, The School of Land and Food Sciences, Australia
Project Leader	Dr Jane O'Sullivan Phone: 07 33654811 Fax: 07 33651188 Email: j.osullivan@mailbox.uq.edu.au
Collaborating Institutions	Ministry of Agriculture and Forestry, Tonga Department of Agriculture Livestock and Horticulture, Vanuatu National Agricultural Research Institute, Papua New Guinea
Project Budget	\$1,101,049
Project Duration	01/07/1999 to 31/12/2006 (Project extended from 01/08/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Gamini Keerthisinghe

Project background and objectives

Yams are staple foodstuffs in many developing tropical countries. Along with their importance in the diet, they also have great cultural significance in many Pacific nations. In addition, they provide income for semi-subsistence farmers, and export revenue for some countries.

In 1995 the Pacific crop was around 288,000 tonnes, or around 42 kg per capita, making it the Pacific's third most important food crop. However, yam production in many Pacific nations has been falling, as intensified farming of other crops has taken over from smallholder production. Imported foodstuffs, often less nutritious than yams but cheaper, are starting to replace yams in the diet. This has serious health implications for the population.

There is still a preference for yams among the islanders, but consumers find the prices too high compared with imported foodstuffs, while farmers are discouraged from growing more than their own needs by a feeling that the prices are too low for what is a labour-intensive crop. Part of the reason for the rather high cost of yam production is the low yields obtained by farmers for the effort invested. This is caused mainly by soil nutrient deficiencies that are reducing both growth and tuber production by the plants.

This project provided information to help in the diagnosis of nutritional disorders affecting yam plants, and sought to develop feasible options for improving crop nutrition in affected areas.

Project outcomes

In laboratory trials at the University of Queensland the researchers produced deficiency symptoms of most of the nutrient elements of interest and established critical concentration values for the macronutrients (nitrogen, phosphorus and potassium) in leaf tissue of two yam species. This was an essential prerequisite to the study of deficiencies in the field.

Surveys of yam-growing areas were undertaken in PNG, Tonga and Vanuatu. The results of the project work throughout the partner countries, using pot experiments to characterise yam nutrient requirements at their selected sites, suggested nitrogen (N), phosphorus (P) and potassium (K) (and sulphur (S) in some places) were major limiting nutrients—findings that agreed with earlier data gathered for sweet potato and taro.

CONCLUDED PROJECTS

Field trials in Tonga and PNG tested a range of legumes to see whether they could improve nitrogen nutrition of the yams. They focused on the use of legumes as green manures, or growing a legume crop as fallow to increase the nitrogen supply in the soil and to recycle phosphorus and potassium. Good results were recorded for Tonga, especially in the area of phosphorus fertiliser field trials and legume fallow species in rotation with yams. The green manure trials found that mucuna (velvet bean) was able to improve phosphorus nutrition of the yam crop.

In PNG there was found to be a growing tension between shorter fallows and/or competition for fertile land for cash crops, and a general decline in soil fertility with a resultant decline in yam production. But this was reassurance that the project was effectively targeting the right issues in PNG, and hence there was significant scope for impact.

The team introduced a novel agroforestry system into PNG, using the leguminous tree *Gliricidia sepium* (gliricidia) as improved fallow and live stake for yam at several locations. Gliricidia poles are planted on a 2 x 2 m grid, with each tree supporting four yam vines. Data from four trial sites harvested in 2003 showed no difference in yield attributable to the staking system, while NPK fertiliser increased yield by 50% (from 18.6 to 27.9 t/ha) on two Bogia District sites but had no effect at two Markham Valley sites.

Preliminary results indicate that, when regularly pruned, the trees do not compete to the detriment of the crop, and can reduce management inputs for weeding and staking. The system may alleviate many of the problems associated with shortened fallows, including weed intensity, decline in soil nutrient availability and organic matter content, and shortage of staking materials. Further benefits to farmers include softer soil texture, enabling the yams to be harvested more easily, and shading of workers at planting and harvest.

In Vanuatu, research at Vanuatu Agricultural Research and Training Centre (VARTC) initially revealed little response by yams to fertiliser in many of the field trials. Therefore the scientists decided to study more closely the growth and development of *D. esculenta* by investigating its rooting structures. Examination of the roots and recording of root length and depth yielded data that called to question the efficacy of placing fertiliser in the mound, leaving researchers to ask where they should place the fertiliser for optimum effect.

A small trial in Brisbane addressed these questions. Strontium was applied to trace root activity and determine the ability of roots to reach a certain location. The experiment showed that yam roots may reach horizontally for at least 5.5 metres and go to depths exceeding 40 cm. A significant observation was that fertiliser placed in the planting hole under the set of plants was rapidly accessed by the plant but that uptake was greater when fertiliser was placed in a ring around the set, within the mound. These findings have great promise for future trials.

7.4 Subprogram 4: Institutional and individual capacity building

Projects:

Active

ASEM/2004/077 Postgraduate Scholarship Scheme for UNITECH, University of Lae,
Papua New Guinea

Concluded

ASEM/2000/162 Scientific communication in Papua New Guinea

ASEM/2004/077: Postgraduate Scholarship Scheme for UNITECH, University of Lae, Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Queensland, School of Land and Food, Australia
Project Leader	Dr Barry W Norton Phone: 07 3289 0260 Fax: 07 3289 0103 Email: b.norton@uq.edu.au
Collaborating Institutions	University of Technology, Head, Department of Agriculture, Papua New Guinea
Project Budget	\$600,605
Project Duration	01/01/2005 to 30/06/2008
ACIAR Research Program Manager	Dr Caroline Lemerle

Project background and objectives

In response to new initiatives by University of Technology (Unitech), Lae, PNG, to introduce a program of post-graduate training in 2005, ACIAR is funding a scholarship program to support students during their training.

It is proposed to provide funding initially in 2005 for six students (stipend plus all costs associated with project administration and research support). It is anticipated that this program will run for three years, training in total nine candidates to Post-Graduate Diploma level and six as MPhil graduates.

Unitech staff will supervise these projects with planning assistance from senior UQ staff, and will be encouraged to seek research linkages with existing ACIAR, NARI and industry projects. Progress will be reviewed each year, and continuation recommended where each year group of students graduates in the prescribed time.

Project Progress

Year 2 (01/01/2006–31/12/2006)

The ACIAR Scholarship Scheme was initiated in the Department of Agriculture at Unitech at the beginning of the first semester in March 2005, when six scholarships were awarded, one for MPhil studies (two years) and five for Post-Graduate Diploma (PGD) studies (one year).

In March 2006, three students graduated with PGDs, with three scholars continuing with MPhil studies (two PGD scholars had been upgraded to MPhil). At this time, a further seven scholarships were awarded for PGD studies. In April 2007, all PGD (Boas, Topi, Yeponge, Taia, Tapat, Butubu, Takaboi) and two MPhil (Tumae, Datoana) students graduated, bringing the total graduated under the scholarship scheme to 12 from 13 appointments.

The remaining MPhil candidate (Rova) has yet to make corrections to her thesis and will graduate in 2008. The topics of research so far conducted have included extension studies with peanut farmers, the incidence of leptospirosis in local cattle, developing sources of traditional feed for pigs and fish (tilapia), genotype x environment interactions in taro, studies of vesicular streak disease of cocoa, virus detection in sweet potato and studies of stem borers in sugar cane.

A public seminar was held at Unitech in October 2006 at which all students presented the results of their studies. In this year, additional support funding was provided for the refurbishment of a laboratory to house new equipment (Inductively Coupled Plasma Atomic Emission Spectrometer (ICP), LECO C:N analyser) to support PG training and research at Unitech.

Installation to operational status will occur in 2007 in association with training of technical staff. Professor Halim (Head of Department of Agriculture) visited UQ to discuss the organisation of post-graduate training and to explore opportunities for research collaboration in his field of extension.

Five new PGD scholars (four males, one female) commenced in February 2007, their topics being local feed source for chickens, pelleting methods for fish feeds (Department of Food Science and Technology), survey looking for peanut yellow stripe virus, local use of indigenous leguminous trees (Department of Forestry) and effects of soil compaction on plant growth. There were no MPhil (2-year) candidates appointed this year because the current ACIAR Scholarship scheme ends in March 2008.

The candidates (two females, three males) were drawn from NARI, NAQIA and local Agriculture. This is the first year that other Departments have been included in the Scholarship scheme. The budget for 2006/2007 was sufficient to meet requirements, and a small surplus will be carried forward to 2007.

ASEM/2000/162: Scientific communication in Papua New Guinea

Bilateral

Overseas Collaborating Countries	Papua New Guinea
Commissioned Organisation	University of Queensland, Australia
Project Leader	Dr Jeff Coutts Phone: 07 4638 9119, 0438 361 153 Email: jeff@couttsjr.com.au
Collaborating Institutions	http://www.scicom.ac.pg
Project Budget	University of Papua New Guinea, Papua New Guinea Papua New Guinea University of Technology, Papua New Guinea Vudal University College, Papua New Guinea
Project Duration	\$1,387,120
ACIAR Research Program Manager	01/01/2002 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006) Dr Ken Menz

Project background and objectives

In PNG the need for training agricultural research scientists in the procedures and techniques for writing and publishing the results of their research had long been an area of concern to government instrumentalities, agricultural research agencies and research funding bodies.

Many short scientific communication courses were organised through various funding bodies (including ACIAR) for different organisations, but were designed to help practising scientists and did not address the underlying gaps in initial training. This had resulted in an ongoing lack of confidence in the communication process.

This project attempted to redress the gaps in Scientific Communication training at the undergraduate level, and to further develop the confidence and skills of both scientists in the field and of journalists reporting to non-scientists on scientific issues.

The purpose of the project was to enhance the scientific communication skills of practising scientists, journalists, lecturers and undergraduate students, and to build the capacity of PNG tertiary institutions to effectively deliver scientific communication training at undergraduate and post-study levels, on a sustainable basis.

Project outcomes

The project successfully developed seven modules together with full supporting material. These were:

- *Communicating With Adults* - a foundation course that covers adult learning principles, their application and the importance of different learning styles in developing communication strategies.
- *Language of Science* - a foundation course for elective subjects that includes special attributes of language and style for effective communication in physical and social sciences and engineering.
- *Science Communication in the Community* - application of appropriate mediums for communicating scientific and technological topics. It includes planning, selection, demonstration and evaluation of a communication product.
- *Writing Scientific Reports* - principles, practical advice and exercises on how to write a scientific report or paper.
- *Transforming Information into Knowledge* - critical review and appraisal of information on a topic from different sources, including use of electronic databases and citation software.

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- *Advanced Roles for Scientists* - five 1-day workshops on activities that established the duties and responsibilities of scientists and engineers - supervising postgraduate students, refereeing and editing of scientific papers; managing a research project; organising a conference; verbal presentations.
- *Directed Product Development* - creation of a communication product for a workplace, supervised by arrangement with the office for the Graduate Certificate of Communication of Science and Technology (conducted in the remote mode over one semester).

Three PNG universities now have accredited post-graduate courses based on the developed modules. The University of Technology Lae accredited the course early in the project as the Graduate Certificate in Communication of Science and Technology. The University of Goroka approved a Post Graduate Certificate & Diploma program and the University of PNG accredited its post-graduate course in 2005 under the School of Science.

The university departments, their libraries and participating staff received substantial support, including copies of the workbook and book of readings for each subject (which they can use without copyright restrictions), copies of key reference books, CD-ROMs containing two databases of references to articles that are relevant to PNG from the natural and social sciences, together with electronic copies of the course materials. Libraries also received a copy of Bibus-biblio – a freeware referencing program. An attractive, user-friendly website (<http://www.scicom.ac.pg/>) was developed to provide a resource for the participating universities and students.

Over the life of the project 225 university lecturers (39% women), researchers and others completed one or more modules. Of these, 129 (including 76 academics and 41 researchers) had graduated by the end of the extended project in December 2006 – far exceeding the initial project objective. Ninety-one university lecturers (22 women) underwent facilitation training to develop their course delivery capacity. Gender sensitivity, inclusiveness and monitoring were important elements of the development, embedding and delivery of the courses. Eleven participants (one male) undertook specific gender training to support their delivery skills.

8 ACIAR Publications

This is a list of ACIAR publications produced in 2006-07. Print copies are available by emailing comms@aciar.gov.au, or electronic versions may be downloaded from ACIAR's website www.aciar.gov.au.

Monographs	
119a	Guidelines for surveillance for plant pests in Asia and the Pacific [Indonesian translation]. Teresa McMaugh, Indonesian translation by Andi Trisyono, 2007, 192 pp.
123a	Agricultural development and land policy in Vietnam [Vietnamese translation]. Sally P. Marsh, T. Gordon MacAuley and Pham Van Hung (eds), Vietnamese translation by Pham Van Hung, 2007, 272 pp.
124	Economically important sharks and rays of Indonesia. W.T. White, P.R. Last, J.D. Stevens, G.K. Yearsley, Fahmi and Dharmadi, 2006, 330 pp.
125	Aquaculture in Papua New Guinea: status of freshwater fish farming. Paul T. Smith (ed.), 2007, 123 pp.
126	Agricultural development and land policy in Vietnam: policy briefs. Sally P. Marsh, T. Gordon MacAulay and Pham Van Hung (eds), Vietnamese translation by P.V. Hung, 2007, 72 pp.
127	Postlarval fish capture and grow-out. Cathy Hair, Regon Warren, Ambo Tewaki and Ronnie Posalo, illustrated by Kisi Mae, 2007, 32 pp.

Proceedings	
122	Improving yield and economic viability of peanut production in Papua New Guinea and Australia. Rao C.N. Rachaputi, Graeme Wright, Lastus Kuniata and A. Ranakrishna (eds), 2006, 118 pp.
124	Heart rot and root rot in tropical Acacia plantations. Karina Potter, Anto Rimbawanto and Chris Beadle (eds), 2006, 92 pp.
125	Coconut revival: new possibilities for the 'tree of life'. S.W. Adkins, M. Foale and Y.M.S. Samosir (eds), 2006, 104 pp.

Technical Reports	
64	Towards improving profitability of teak in integrated smallholder farming systems in northern Laos. Stephen Midgley, Michael Blyth, Khamphone Mounlamai, Dao Midgley and Alan Brown, 2007, 96 pp.
65	A review of animal health research opportunities in Nusa Tenggara Timur and Nusa Tenggara Barat provinces, eastern Indonesia. Bruce M. Christie, 2007, 76 pp.
66	Modelling minimum residue thresholds for soil conservation benefits in tropical, semi-arid cropping systems. M.E. Probert, 2007, 36 pp.

Working Papers	
62	Report on a review of ACIAR-funded projects on Rhizobium during 1983–2004. David F. Herridge, 2006, 48 pp.
63	Economics and market analysis of the live reef-fish trade in the Asia–Pacific region. Brian Johnston (ed.), 2007, 172 pp.

Impact Assessment Series Reports	
44	Impact assessment of capacity building and training: assessment framework and two case studies. Jenny Gordon and Kevin Chadwick, 2007, 120 pp.
45	Development of sustainable forestry plantations in China: a review. John W. Turnbull, 2007, 78 pp.
46	Mite pests of honey bees in the Asia–Pacific region. Michael Monck and David Pearce, 2007, 32 pp.
47	Improved Australian tree species for Vietnam. Hayden Fisher and Jenny Gordon, 2007, 36 pp.
48	Assessment of capacity building: overcoming production constraints to sorghum in rainfed environments in India and Australia. Chloe Longmore, M. Cynthia Bantilan and Jenny Gordon, 2007, 44 pp.
49	Minimising impacts of fungal disease of eucalypts in South-East Asia. Hayden Fisher and Jenny Gordon, 2007, 36 pp.
50	Improved trade in mangoes from the Philippines, Thailand and Australia. Michael Monck and David Pearce, 2007, 48 pp.
51	Growing trees on salt-affected land. James Corbishley and David Pearce, 2007, 44 pp.

Corporate publications	
w	ACIAR Annual Report 2005–06. October 2006
	ACIAR Annual Operational Plan 2007–08. June 2007
	Adoption of ACIAR project outputs: studies of projects completed in 2002–2003. J. Gordon and J. Davis (eds), 2007, 64 pp.
	ACIAR Publications Catalogue 2007
	Partners in Research for Development magazine Winter 2006 Spring 2006 March–June 2007 July–October 2007
	More crop per drop from Australian International Research (Report on how Australian benefits from ACIAR water research)

www.aciar.gov.au

ACIAR is an Australian Government Statutory Authority that operates within the portfolio of Foreign Affairs and Trade. ACIAR aims to enhance rural household incomes and broader economic growth by investing in international research partnerships that encourage agricultural development, sustainable use of natural resources and capacity-building of benefit to partner countries and Australia.

ACIAR works collaboratively with AusAID in areas of mutual priority, with both organisations contributing to the whole-of-government emphasis of the aid program.

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