

Country Profile

# **Papua New Guinea**

**November 2005**

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

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# Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our key partner countries. This publication contains short summaries of both bilateral and multilateral projects with Papua New Guinea that were active at 30 June 2005. At that time there were 37 active bilateral projects and 3 active multilateral projects, the latter being led by international agricultural research centres. There were another 18 projects under development, many of which are expected to start in 2005–06 financial year.

This publication also sets out the key outputs and outcomes from 1 bilateral project that was completed at 30 June 2005.

In addition to these project summaries, the publication includes an extract from ACIAR's 2004–05 Annual Report covering Papua New Guinea, our near-term program as outlined in the 2005–06 Annual Operational Plan, and a record of the most recent consultations held between ACIAR and Papua New Guinea on the medium-term priorities for the joint program.

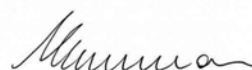
ACIAR will update this profile each year and distribute it to key stakeholders in Papua New Guinea and Australia.

We hope you find the publication useful as a record of the ongoing progress and achievements of ACIAR's collaborative research and development program with Papua New Guinea. For information on ACIAR's overall program, we invite you to visit our website at [www.aciar.gov.au](http://www.aciar.gov.au).



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# Papua New Guinea Report 2004–05

(extract from ACIAR Annual Report 2004–05)

## Papua New Guinea

Active projects in 2004–05	38
AOP budgeted expenditure in 2004–05	\$3,330,000
Actual bilateral country expenditure in 2004–05	\$4,226,822
Bilateral country expenditure in 2003–04	\$3,346,297
Bilateral country expenditure in 2002–03	\$3,171,113

Key performance indicators	Performance 2004–05
<ul style="list-style-type: none"> <li>Growth in program budget for PNG compared with 2003–04</li> </ul>	2004-05 budget at \$4.2 m, compared to 2003-04 budget of \$3.35 m
<ul style="list-style-type: none"> <li>Increased emphasis on project with effective technology transfer components, including commencement of at least two new projects involving NGOs</li> </ul>	One forestry project involves local NGO, OISCA; a second includes the Foundation for People and Community Development.
<ul style="list-style-type: none"> <li>Graduation of at least two more PNG John Allwright Fellows</li> </ul>	Two further PNG students graduated in 2004–05 through John Allwright Fellowships.
<ul style="list-style-type: none"> <li>Development of a strategy for collaboration with NAQIA on quarantine aspects of fruit flies</li> </ul>	Strategy agreed with new collaborative project involving several PNG agencies under design, and proposed collaboration with NAQIA on: quarantine and surveillance training; and development of quarantine identification packages for fruit fly.
<ul style="list-style-type: none"> <li>Inclusion of improved growth and yield modeling tools into national forest planning processes</li> </ul>	The draft PNG National Reforestation Policy includes development of a five-year national forest management programme to improve stocking. The National Eco-forestry Policy identifies lack of yield information as planning constraint.
<ul style="list-style-type: none"> <li>Expansion of new and more effective payment system for smallholder oil palm producers</li> </ul>	A payment trial at Hoskins saw productivity increase by 90% on blocks involved. Participants reported: utilisation of under-employed labour; greater financial security and more equal income distribution.
<ul style="list-style-type: none"> <li>Pilot testing of new vegetable supply chains from the highlands to major lowland urban population centres</li> </ul>	PNG Fresh Produce Development Company conducted four airfreight marketing trials involving fresh produce from Eastern Highlands Province.

Key performance indicators	Performance 2004–05
<ul style="list-style-type: none"> <li>Documentation of the current and potential role of peanut production in smallholder farming systems</li> </ul>	<p>The National Agricultural Research Institute conducted and published peanut farmers' survey covering four provinces, generating information on production, storage, utilisation, marketing systems and aflatoxin contamination.</p>

## Position

Papua New Guinea (PNG) is an important partner country for ACIAR, reflecting the long-term relationship between Australia and PNG. Australia's commitment to seeing PNG develop and prosper makes our nearest neighbour Australia's largest development partner, with a development cooperation program of more than \$300 million. The size and priority given by ACIAR's to its program with PNG reflects this, with funding having increased significantly in recent years. Since 1998 ACIAR and AusAID have worked together to develop and fund a small set of projects of mutual interest. To enhance the adoption of research results, ACIAR involves the private sector and NGOs in applicable projects.

ACIAR's program aims to address some of the formidable challenges in PNG's agricultural development. The country is a net food importer with high population growth. Village-based agriculture supports between 70 and 80 per cent of the population with domestic trading of fresh produce a very important source of cash incomes. ACIAR's strategy in PNG is to support applied technical and economic research to enhance smallholders' income. Root, plantation and horticulture crops, fish and forestry are focal points for research. Subjects include both export crops and domestically traded crops to generate smallholder income, and to support food security. Ensuring the continued sustainability of renewable resources, such as fisheries and forests, along with crop and livestock biosecurity are essential components of research. The PNG program also has a strong emphasis on capacity-building, both within projects and through postgraduate training for selected scientists involved in ACIAR projects.

## Achievements

**Studies to improve marketing systems** have shown how to better utilise the potential of growing vegetables year-round in the unique PNG highlands environment to supply domestic markets (see box). Trial shipments are under way to assess both the strengths and weaknesses of the market chain and the level of success in meeting consumers' expectations. The productivity of the cocoa, coconut and oil palm industries has increased by boosting the participation of youth and women. Past ACIAR research helped to increase women's participation in the oil palm industry in West New Britain Province, helped by the refinement of ownership and labour payment arrangements. Women received payment for collecting fallen palm fruit through a card scheme. Now this scheme is being extended to families, using a similar card. The new project is evaluating this success to determine key lessons, revealing that productivity increased by an average of 38 per cent across 90 per cent of the smallholder plantation blocks participating. The findings will guide efforts to launch pilot schemes beyond the original oil palm sector, particularly for coffee and cocoa.

### Improving the supply of fresh produce

Jonah Waipek, like many farmers in the South Waghi Vegetable Producers Association, is yet to reap reward from the unique potential of Papua New Guinea's highlands. Soils in the highlands are rich enough to grow vegetables year-round. In a country where food security relies on imports, tapping this potential could increase food availability and provide incomes to smallholder farmers.

The main problem facing Jonah and his colleagues is not meeting demand, but finding markets for their produce. Much of what they grow—cabbage, taro, cassava, pumpkin, sweet potato, broccoli and tomato—is simply not sold. It is only on Fridays that the Association has a regular buyer. Each week the Kubutu Mine picks up a quantity of vegetables. These are picked the previous day, but often vegetables close to being ripe are included, rather than going to waste.

ACIAR has commissioned the University of Canberra to help determine how the Association, and other groups like it, can tap into existing markets. Project leader Professor John Spriggs has discussed the factors that prevent potential buyers, such as supermarkets, from working with highland producers. The main issue raised was reliability of supply.

For Jonah and the Association's other producers the real issues are infrastructure problems, both at the village level and beyond. The lack of a cool room facility makes preserving produce very difficult, and poor communications and transport routes prohibit the growers from contacting buyers and delivering to them.

This information, together with input from extension workers, is being collated to develop a map of the marketing chains in the highlands. The result is a concept paper, designed to help key stakeholders throughout the system understand the possibilities for their industry. Already the Government and other groups with a role to play in developing markets have adopted the vision.

Work has now shifted to implementing the paper's key strategies. Jonah and his fellow farmers can look forward to tapping into markets on a more regular basis.

The forestry sector is another where research is developing new markets by utilising indigenous resources. **PNG's forests have several species that are the source of valuable products**, but the country has limited capacity to exploit these sustainably, both in the smallholder and research sectors. One project is utilising essential oils found in some tree species. Villagers have long produced these oils for medicinal purposes by crushing leaves. The project has determined methods for bulk production and commercial sale, with several villages now selling to commercial markets. The additional returns have helped to build a school and improve community health through greater access to medicine and better hygiene.

Two other forestry projects are building up the capacity of the PNG Forest Research Institute—a part of the National Forest Service. One is developing planning techniques and improving databases built on information collected during project activities. The other is building capacity in the domestication of indigenous tree species. Researchers are **mapping the natural distribution of several species** and undertaking seed collection. Field trials to assess performance are under way, along with conservation strategies for two key species. They have also propagated some key species.

Fisheries resources are another potential income source. One project links in with research to increase available dietary protein and establish smallholder enterprises through **building capacity in inland pond aquaculture**. Surveys of between 300 and 400 farms, institutions and markets involved in the industry across seven provinces are in progress to develop a picture of the industry.

Sustainable management of PNG's fisheries is vital to their long-term health and ability to generate income for the national economy. **Two inter-related projects are focusing on the Gulf of Papua prawn fishery**. A model of this fishery integrating biological and economic data is in the latter stages of development. The related project is gathering biological data to assess the level of prawn stocks in the Gulf. The initial survey is gathering data on the characteristics of the fishery, size of catches and frequency at which vessels operate.

Two projects addressing **livestock management** are in progress. The first is examining how to reduce feed costs for broiler chickens. The industry, worth around A\$50 million a year, could increase profitability, especially amongst smallholder participants, if **local feed resources could be utilised to replace imported grains**. Cassava, sweet potato and palm kernel meal are all suitable to meet feed requirements of chickens. The research team has also collected data for current farm settings and feed costs. The second project, also active in Indonesia and the Philippines, has developed diagnostic and control methodologies for the disease Surra. In PNG the blood sample collection protocols developed are now in use by National Agriculture and Quarantine Inspection Service staff.

Agricultural research scientists need good skills to write their results for publication to ensure dissemination of research outcomes. A project to develop graduate courses in scientific communication has helped to enhance these essential scientific skills. A complete graduate course is now available at the University of Technology, Lae. More than 200 **scientists are now enrolled and 70 have graduated**. Another five universities are helping to develop the course of four units. An extension of the project will support this process.

Support for the cocoa industry is being provided in several projects. The first, completed during the year, **evaluated new approaches to drying cocoa**. Mini-box dryers and solar dryers, alternatives to kilns that cause smoke damage to cocoa, were tested and the most effective used as benchmarks in drafting revisions to PNG's cocoa regulations and related legislation. Improved cocoa varieties are now being released after quality assessment. Staff members of the PNG Cocoa and Coconut Institute have received training to help bring identified improvements to smallholders. Training manuals written for the differing needs and approaches of men and women in applying the technology are now in use by extension agencies. A recently-commenced project is working to address another research need—**improved cocoa disease control by smallholder producers**.

Improved postharvest management of another important commodity—sago—has built on project outcomes to date by **identifying conditions most likely to lead to contamination during storage**. Moist conditions in bulk storage containers can allow fermentation (caused by microbes) resulting in contamination. Researchers are now trying to identify microbes and microbial metabolites involved in fermentation and determine optimum storage periods to limit contamination.

Protecting crops from pre-harvest threats is paramount. In 2003 an **outbreak of potato late blight**, caused by *Phytophthora infestans*, significantly reduced yields. A new project is investigating this outbreak in an effort to develop effective control.

A project active in PNG, Indonesia and Australia has mapped sugarcane pests and diseases. Research has now extended to survey key areas to build up a comprehensive picture of pest and disease distribution. The causal agent of one disease, Ramu stunt, is being investigated and **screening for resistance** against a second disease, smut, is progressing. Results have been passed to quarantine staff in all three countries.

Two pests of horticultural crops—*Oribius weevil* and the red-banded mango caterpillar—are under study. The damage caused by the weevil has been determined with **treatments to exclude adult weevils from some plants resulting in price premiums** of up to 200 per cent—despite these treatments only reducing adult populations (and their damage) by half. Citrus plants fared even better—previously unprotected plants that produced no fruit started to yield again. Host plants for *Oribius* species were identified and the role of roots as food for larvae determined. Seven *Oribius* species were identified as pests in PNG. Data on the **incidence of red-banded mango caterpillar** as a pest have been collected during the past fruit season. This revealed average losses attributed to the caterpillar of around 55 per cent, also that mango cultivars are susceptible. Work continues to learn more about its lifecycle and control using pheromones and chemicals.

The use of biocontrol agents against the invasive weed *Chromolaena odorata* continues to gain momentum in PNG. Dissemination of the gall fly as a biocontrol has produced a two-fold benefit. **The fly has now been released in 11 provinces** at 70 separate sites. Populations are now established at 63 sites and in many cases have spread to infested areas within a 40 kilometre range. Increased public awareness of the weed and the need to report locations where it has taken hold has assisted its continued management and guided the release of the gall fly.

A suite of four projects aims to introduce improved varieties and better management strategies for **staple foods and income-generating crops**. Sweet potato provides around 30 per cent of total food calories in PNG. New varieties with some resistance to drought and increased yields have become available and are now being tested for their suitability prior to multiplying the best varieties for broader distribution. A similar project aimed at introducing improved peanut cultivars has introduced and tested high-quality lines from the ICRISAT collection that yield between 50 and 100 per cent above currently used varieties.

The link between magnesium (Mg) in volcanic soils and oil palm growth is being investigated, and **links established between low soil Mg levels and low tissue Mg** in adult trees. Tests to alleviate the deficiency are under way.

The use of clonal propagation of coconut to introduce improved disease-free germplasm has moved a step closer through a new protocol for raising seedlings. Scientists have successfully tested the viability of using transplants of germinated zygotic embryos (from fertilised cells). **Methods to improve the establishment and growth of such embryos** have also been developed.

# Papua New Guinea Plan 2005–06

(extract from ACIAR Annual Operational Plan 2005–06)

GNI per capita <sup>1</sup>	AUD 786	Bilateral actual 2003–04*	\$3.4m
Population <sup>2</sup>	5.3 million	Bilateral forecast 2004–05*	\$4.3m
Population 2025/2050 <sup>3</sup>	8.4 / 11.1 million	Bilateral budget 2005–06*	\$4.5m
Active bilateral projects <sup>4</sup>	35	Multilateral budget 2005–06	\$0.3m
Active multilateral projects <sup>5</sup>	2		

\*Includes AusAID-funded projects: \$1.5m (actual 2003–04), \$2.2m (forecast 2004–05), \$2.3m (budget 2005–06).

## 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. The social and economic context of the research is emphasised, particularly with respect to involvement of women farmers. There is an emphasis on root, plantation and horticultural crops and fisheries. This includes both export crops and domestically traded crops that generate smallholder income, along with support for improved food security. Project design encourages private sector, industry and non-government organisation (NGO) linkages. Sustainability of renewable resources is encouraged through programmatic emphases on biosecurity and on sustainable management of forest and fisheries resources. The PNG program has a strong emphasis on capacity building, with high priority both to training within projects and postgraduate training.

## Key performance indicators (2005–06)

- Enhanced focus in project portfolio on improving the processing quality of commodities
- Linkages between at least three ACIAR projects and three AusAID-funded AIGF (PNG Agricultural Innovations Grant Facility) projects established
- Greater involvement of PNG University of Technology in ACIAR's program, including linkages to other PNG research institutions
- Assistance with the institutionalisation of participatory action research (to focus research on smallholder needs)
- Increased emphasis on sweet potato research and development in ACIAR portfolio, commensurate with its importance as a staple food

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

<sup>2</sup> Source: United Nations Population Division, 2004, *World Population to 2300*.

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

<sup>4</sup> For all country chapters this figure indicates active bilateral projects as at June 2005.

<sup>5</sup> For all country chapters this figure indicates active multilateral projects as at June 2005.

- Potential role of indigenous nuts in local economies defined
- Extent and severity of nutritional disorders in oil palms and impact on yields quantified and suitable amendments identified
- Fingerling production and supply to inland fish farmers significantly improved in quantity and quality
- 40% of new projects designed to have significant farmer or policy-maker impacts within 5 years of completion

## 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 ACIAR and AusAID have worked and continue to work together to develop and fund a set of projects of mutual interest. In 2003, AusAID established the PNG Agricultural Innovations Grant Facility (AIGF), which supports small projects in PNG agricultural research and extension institutions. Many of these projects relate to previous or current ACIAR-funded projects at these institutions, and during 2005–06 linkages between ACIAR and AIGF projects will be strengthened.

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% 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, for instance 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 to developing policy for PNG's food security. A current project is establishing scientific communication training in the country's universities.

PNG's relative lack of resources and expertise is a constraint in R&D activities and in delivery of extension services. This was highlighted at the National Extension Summit held in Lae in May 2004. It is therefore crucial, when designing projects, to include training and packaging of research results for uptake by farmers.

## **Indicative priorities**

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](http://www.aciar.gov.au) under Partner country priorities/Papua New Guinea.

At the consultation, consensus was achieved 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, farming systems, protection and postharvest technology of crops, fisheries and forestry, with a limited number of projects in livestock production and soil management and crop nutrition.

The priorities are grouped under four programmatic themes:

- Applied research aimed to maintain and enhance smallholder incomes, with an emphasis on root, plantation and horticultural crops and fisheries. 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, socioeconomics and project assessment, through development of human and physical resources

Major training priorities, in addition to those offered within projects and through postgraduate degrees, include experimental design and statistical analysis, including management of data quality; research management; research priority setting, monitoring and evaluation and impact assessment; scientific proposal writing and project design; presentation for scientific, extension, farmer and government audiences; and collection and analysis of market information and training in extension approaches, including farmer participatory action research.

### ***Interventions to maintain and enhance smallholder incomes***

#### *Root and horticultural crops*

- Conservation, characterisation and utilisation of plant genetic resources (sugar, banana, taro, sweet potato, yam)
- Improved productivity and nutrition from smallholder farming systems, especially those based on sweet potatoes and peanuts
- Management of potato late blight and of pests and diseases of sweet potato and other root crops
- Postharvest handling and storage of sweet potatoes
- Integrated crop management for highland vegetable production
- Alternative crops to highland coffee, including horticultural and floriculture crops
- Market chain analysis (including quality incentives) for key commodities

#### *Tree crops*

- Cocoa and coffee marketing, quality management and crop protection
- Management of key insect pests and diseases of perennial fruit and tree crops and oil palm

### *Village livestock and aquaculture*

- Enhanced productivity of existing inland pond aquaculture systems, and investigation of new opportunities including the domestication of indigenous species.
- Development of cost-effective formulated freshwater aquaculture feeds suited to local production
- Assessment of market options and opportunities for aquaculture production
- Low-cost feeds and feeding systems for chickens and pigs

### *Forestry and agroforestry*

- 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, including utilisation of coconut wood and lesser known species
- Improvement of traditional agroforestry systems, including fallow rotations, coffee, cocoa, vanilla cover crop management
- Development of lesser-known non-timber forest products for communities (including fruits, nuts, fodder, oils and resins)

## ***Sustainable management of soil, forestry and fisheries resources***

### *Soil*

- Maintenance of soil fertility in response to intensification of land use for annual and plantation crops
- Improving accessibility and usability of soil and land classification systems in PNG for use at both the field level and in making policy and investment decisions
- Implementation of research into coping strategies to address climatic extremes (drought, frost, excess rainfall) in vulnerable provinces

### *Forestry 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

### *Fishery resources*

- Simple village-level mariculture options for enhanced livelihoods and to provide 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 domestication policies and strategies for the long-line tuna fishery
- Assessment of impacts of fish-attracting-device associated tuna fisheries on resource sustainability, particularly the capture of juvenile bigeye and yellowfin tuna

### *Biosecurity*

- Capacity building for diagnosis and integrated management of plant pests, diseases and weeds

- Risk analysis and contingency planning for high-risk plant pests and livestock diseases

*Institutional capacity building, socioeconomics and project assessment*

- Analysis of international comparative market advantage of selected PNG agricultural commodities
- Research addressing social and economic constraints and opportunities in smallholder production systems
- Institutional strengthening strategies for agricultural education and analytical services
- Approaches to R&D project planning frameworks and impact assessment
- Researching alternative approaches to extension

**Program Adviser**

Dr Ken Menz

**Key program managers**

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Mr Barney Smith, Fisheries  
Dr Russell Haines, Forestry  
Dr Greg Johnson, Postharvest Technology  
Dr Christian Roth, Soil Management and Crop Nutrition

**Country Manager**

Ms Margaret Newman, ACIAR Country Manager, PNG and Solomon Islands

# Active projects

at 30 June 2005

## Bilateral

AH/2000/009	Development of diagnostic and control methodologies for animal trypanosomiasis (Surra) in Papua New Guinea, Indonesia, the Philippines and Australia	19
AH/2001/054	The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific	21
ASEM/2000/162	Scientific communication in PNG	23
ASEM/2001/037	Improving the marketing systems for fresh produce of the highlands of PNG	24
ASEM/2001/055	Improving yield and economic viability of peanut productions in Papua New Guinea and Australia using integrated management and modelling approaches	26
ASEM/2002/041	Improving productivity and the participation of youth and women in the Papua New Guinea cocoa, coconut and oil palm industries	28
ASEM/2002/050	Economic performance and management of the Gulf of Papua prawn fishery	30
ASEM/2003/010	Farmer evaluation and multiplication of sweet potato varieties on the North Coast of PNG	31
ASEM/2004/011	Evaluating domestic tuna fisheries projects	33
ASEM/2004/042	Assessing and extending schemes to enhance the profitability of the PNG coffee industry via price premiums for quality	34
CIM/1998/061	Coconut tissue culture for clonal propagation and safe germplasm exchange	35
CP/1994/043	Virus indexing and DNA fingerprinting for the international movement and conservation of taro germplasm	37
CP/1996/091	Biological control of Chromolaena odorata in Indonesia, Papua New Guinea and the Philippines	39
CP/1996/140	Biological threats to Saccharum germplasm and sugar production in Papua New Guinea, Indonesia and Australia	41
CP/2001/032	Impact and management of Oribius weevils in Papua New Guinea	43
CP/2002/013	Biology, damage levels and control of red-banded mango caterpillar in Papua New Guinea and Australia	44
CP/2003/029	Management of potato late blight in Papua New Guinea	45
CP/2004/001	Taro Pest: A computer based information and diagnostics package for taro pests of the South Pacific	46
FIS/2001/075	Sustainable aquaculture development in Pacific Islands region and northern Australia	47
FIS/2001/083	Inland aquaculture in PNG: Improving fingerling supply and fish nutrition for smallholder farms	49

FIS/2002/056	Biology and status of the prawn stocks and trawl fishery in the Gulf of Papua	50
FIS/2005/022	Cross-institutional exchange: work placement at the Highlands Aquaculture Extension and Development Centre (HAQDEC), Aiyura, Eastern Highlands Province PNG	51
FST/1998/113	Development of a sustainable, community-based essential oil industry in the Western Province of Papua New Guinea using the region's woody-plant species	52
FST/1998/115	Domestication of Papua New Guinea's indigenous forest species	54
FST/1998/118	Planning methods for sustainable management of timber stocks in Papua New Guinea's forests	56
FST/2002/010	Domestication and commercialisation of multi-purpose indigenous trees and shrubs for food and other products in Papua New Guinea, the Solomon Islands and Queensland: a feasibility study with special reference to Canarium nut	58
FST/2003/049	Review of portable sawmills in the Pacific: Identifying the factors for success	60
FST/2004/009	Facilitating the availability and use of improved germplasm for forestry and agroforestry in Papua New Guinea	61
FST/2004/049	Mastotermes scoping study in PNG	62
FST/2005/050	PNG agroforestry systems – scoping study	63
LPS/2001/077	Poultry feeding systems in PNG	64
PHT/2001/016	Micorbial contaminants associated with sago processing and storage in Papua New Guinea	66
PHT/2003/015	Enhancing PNG smallholder cocoa production through greater adoption of disease control practices	68
SFS/2001/036	Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks	69
SMCN/1998/028	Diagnosis and correction of nutritional disorders of yams	71
SMCN/2000/046	Overcoming magnesium deficiency in oil palm crops on volcanic ash soils in Papua New Guinea	73
SMCN/2005/043	Analysis of biophysical and socio-economic constraints to soil fertility management in the PNG Highlands	75
<b>Multilateral</b>		
CP/2000/044	Taro beetle management in PNG and Fiji	76
FIS/1999/025	Optimal release strategies for restocking and stock enhancement of the tropical sea cucumber, sandfish ( <i>Holothuria scabra</i> )	78
SFS/2001/068	Technical support for regional plant genetic resources development in the Pacific	80



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

<b>Overseas Collaborating Countries</b>	Indonesia, Papua New Guinea, Philippines
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<b>Collaborating Institutions</b>	Research Institute for Veterinary Science, Indonesia Provincial Animal Production Department, Irian Jaya, Indonesia National Agriculture and Quarantine Inspection Service, Papua New Guinea University of Southern Mindanao, Philippines Department of Agriculture, Region XI, Philippines Disease Investigation Centre, Sulawesi, Indonesia University of Western Sydney, Australia
<b>Project Budget</b>	\$600,002
<b>Project Duration</b>	01/01/2001 to 31/12/2005 (Project extended from 01/01/2004 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr Peter Rolfe

**Project background and objectives**

The disease of animal trypanosomiasis (or surra) is caused by the protozoan parasite *Trypanosoma evansi*, transmitted by biting tabanid flies (March flies). As with sleeping sickness in humans, the result of infection is an acute or chronic wasting, depending on host susceptibility and the virulence of the parasite strain. Many animals can be afflicted, including livestock and horses. The disease is found in much of the world, including all of the Philippines and Indonesia. Evidence from antibodies in blood samples shows that *T. evansi* may be present in parts of Irian Jaya. However, Australia and, it appears, Papua New Guinea (PNG), remain free of the disease.

Recent research has shown that pigs and deer could be efficient reservoir hosts for the parasite in PNG (pigs are widely infected in the Philippines), and two species of wallaby common in New Guinea and northern Australia are highly susceptible to infection and suffer acute disease with a high mortality rate. Therefore if the disease were to enter Australia or PNG, it would have a devastating effect on livestock and probably on many native marsupials.

Before any control programs can be designed, more needs to be known about the impact of *T. evansi* on livestock and the determinants of clinical disease. This requires sensitive and well-validated diagnostics tests, coupled with an understanding of the genetics of virulence in the different strains of *T. evansi*. Currently, there are no such effective tests, and drugs used in treatment have not been systematically evaluated.

Both Indonesia and the Philippines would like to establish control mechanisms to reduce livestock infection and improve productivity. This project therefore involved both countries, along with PNG and Australia, building on research into the parasite carried out at James Cook University, Townsville (ACIAR project AS1/1996/150). This earlier work demonstrated the inadequacy of existing diagnostic tests.

To develop accurate diagnostic tests for this parasitic disease and more effective ways of controlling it, and to transfer this technology to neighbouring countries to improve surveillance and reduce the risk of disease entry to Australia.

## **Project progress**

**Year 4 (01/01/2004–31/12/2005)**

### *Determine the socio-economic profile of surra in Mindanao*

A workshop was held in Davao in September 2004 to provide training for project staff as well as veterinary staff from other regional offices who form part of the Mindanao Unified Surra Control Approach (MUSCA) program. Preliminary results from a field visit during the workshop showed that carabao are the most important livestock species and that their value is measured by their use as draft animals. If an outbreak of surra occurred mortality in carabao would significantly reduce the capacity of farmers to generate income and provide food from the production of cash crops.

Two preliminary surveys to determine the prevalence of infection with *T. evansi* in carabao have been performed in a region of Mindanao where there is no evidence of clinical surra (Bukidnon) and in a region that has experienced a recent outbreak of surra (Surigao del Norte). Results showed that there is a significant difference in the serological prevalence of infection between the two regions determined. The prevalence of parasitaemia with *T. evansi* in Surigao del Norte was high (12.5 per cent), which suggests that transmission of *T. evansi* is still occurring despite intensive use of trypanocidal drugs in the area with Diminazine aceturate (Trypan).

The next phase of this work will be to design a longitudinal survey of carabao in these two areas. This will be completed during a site visit in May 2005.

### *Determine the efficacy of cymelarsan for the treatment of chronic *T. evansi* infection*

An experiment was conducted at Balitvet to re-evaluate if different isolates of *T. evansi* from Indonesia vary in their susceptibility to cymelarsan. A series of experiments conducted as part of the original AS1/2000/009 was unable to unequivocally prove this mainly because of the need to use small experimental groups (5). The results show that there is no significant difference between the sensitivity of each of three isolates of *T. evansi* to cymelarsan. This is important because it suggests that Indonesian isolates of *T. evansi* are likely to be reasonably homogeneous in their susceptibility to treatment with cymelarsan.

A larger experimental infection study is now underway at Balitvet to determine the efficacy of cymelarsan for the treatment of buffalo chronically infected with *T. evansi*.

### *Develop control programs and extension packages*

The development of a training manual and extension material for surra in the Philippines will proceed once data from surveys conducted late in 2004/early 2005 is available.

### *Consolidate technical capacity in Australia and PNG for detection of *T. evansi**

Field validation of the Whatman FTA cards for the collection of blood samples in PNG and northern Australia proceeded as planned. The sample collection protocol proved to be achievable under field conditions and has now been adopted by staff working in the NAQS program.

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

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Papua New Guinea, Tonga
<b>Commissioned Organisation</b>	Murdoch University, Division of Veterinary and Biomedical Sciences, Australia
<b>Project Leader</b>	Dr Simon Reid Phone: (08) 9360 7423 Fax: (08) 9310 4144 Email: sreid@central.murdoch.edu.au
<b>Collaborating Institutions</b>	National Agriculture and Quarantine Inspection Service, 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
<b>Project Budget</b>	\$554,679
<b>Project Duration</b>	01/01/2002 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
<b>ACIAR Research Program Manager</b>	Dr Peter Rolfe

### **Project background and objectives**

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. Zoonotic diseases are capable of being transmitted directly from animals to humans. 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.

Zoonotic diseases (diseases transmitted from animals to humans) are thought to be increasing in the South Pacific as livestock production intensifies. The project is working to determine the extent of the problem posed by zoonotic diseases, and to develop control strategies to reduce their impact.

### **Project progress**

#### **Year 3 (01/01/2004–31/12/2005)**

*Development of the capacity for effective surveillance:* Training was provided to a technician from the NVL in the use of an antibody detection ELISA to detect infection with *Leptospira* spp and *Trichinella* spp during a workshop at Murdoch University.

*Determine the prevalence of Trichinella, Leptospira and A. cantonensis infection in livestock:* Results of surveys conducted in Papua New Guinea (PNG) show that there is a high prevalence of infection with *Leptospira* spp in cattle in PNG and it is a significant cause of infertility in affected herds. These results show that the prevalence of infection is higher in large commercial herds and that there is evidence that attempts to control infection using vaccination have failed. However, the reasons for this apparent failure may relate to management issues and not the failure of vaccination *per se*. Further work is required to determine the optimal vaccination strategy.

A comparison of data from testing humans and animals was made in two villages in Fiji. This revealed that in the village that experienced human cases of leptospirosis the pattern of serovars affecting the human population most closely resembles the profile found in domestic dogs, opening up the possibility of interventions by vaccination of village dogs or by modifying the contact between the species.

Results from testing a total of 108, 48 and 73 serum samples collected from pigs from Fiji, Tonga and Kiribati respectively showed that the prevalence of antibodies to *Trichinella* were low. Only three pigs and one mongoose from Fiji were shown to have high levels of antibodies, which suggest that infection, if present is sporadic and may be present in Mongoose. Further work is required to determine the presence or absence of *Trichinella* in Mongoose because they are abundant and relatively easy to trap.

A field visit to Kikori in April 2004 investigated the potential source of *Trichinella* isolated from farmed crocodiles in Lae. This revealed that crocodiles held in the villages are fed on wild pig meat and fish prior to transport to the crocodile farm in Lae. It is likely that pigs are the source of *Trichinella* because larvae were recovered from the meat of a wild pig sold at Kikori market.

*Investigate the pathogenesis of T. papuae in pigs and Angiostrongylus cantonensis:*

Experimental studies in PNG showed that the larvae of *T. papuae* remain infective in pig meat for up to 26 days at 5°C and for 9 days in meat maintained outdoors at ambient temperature (32°C). This is important because it shows that surveys to recover *Trichinella* from animals in remote locations are possible if tissue samples can be refrigerated.

There was no evidence of clinical or subclinical disease induced by experimental infection of two merino cross-bred ewes with at least 1,000 L3 larvae of *A. cantonensis*. This suggests that *A. cantonensis* is not a significant pathogen of sheep.

## **Project ASEM/2000/162: Scientific communication in Papua New Guinea**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	University of Queensland, Australia
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<b>Collaborating Institutions</b>	University of Papua New Guinea, Papua New Guinea University of Technology, Papua New Guinea Vudal University College, Papua New Guinea
<b>Project Budget</b>	\$1,387,120
<b>Project Duration</b>	01/01/2002 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

### **Project background and objectives**

Investigators have established the need to improve scientific communication at the tertiary level in PNG at undergraduate, graduate and post-study levels. While there have been some short scientific communication courses organised in PNG these have targeted practising scientists. This project is redressing the gaps in scientific communication training at the undergraduate level, and to further develop the confidence and skills of research scientists and of journalists who report on scientific issues to non-scientists.

The trainers are focusing on development of a common curriculum for participating institutions and departments, and training teaching staff to present the courses and to continue delivering training beyond the life of the project.

### **Project progress**

#### **Year 3 (01/01/2004–31/12/2004)**

By October 2004, more than 200 people had participated in the program. About 70 were expected to complete the four modules required to graduate in March 2005. The project was during 2004. Providers have explored several options for reducing workshop costs.

During 2004, seven graduates from the 2003 enrolments were trained in facilitation and subsequently facilitated one or more courses, bringing the pool of trained facilitators to 17, after eight of the 2002 core lecturer group became unavailable.

The project has attracted a satisfactory balance of research scientists (33 per cent) and university lecturers (56 per cent) but journalists and extension workers were not well represented (four per cent). Female participants made up 27 per cent of the total. Overall, 116 participants were from universities, 69 from research institutes (agriculture, forestry and medical research), nine from extension agencies, and 13 from miscellaneous categories.

The project team conducted an online survey of current and past participants in October and November 2004. Of the 56 respondents, 23 were university lecturers. Of these 15 (65 per cent) gave examples of how they had incorporated some of their learning into their university teaching/courses. Thirty-five of the 56 respondents listed communications activities they had undertaken as a direct result of their participation in the course, including preparation and submission of research papers, and presentations to specialist and generalist audiences.

The universities involved in the project are progressing proposals that will embed SciCom principles and approaches in existing institutional structures, but require support until these processes are complete. Following an external review in November 2004, ACIAR agreed to extend the project till December 2006, with a tight focus on issues of institutionalisation and sustainability.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	University of Canberra, Australia
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<b>Collaborating Institutions</b>	National Agricultural Research Institute, Papua New Guinea Fresh Produce Development Company, Papua New Guinea University of Technology, Papua New Guinea
<b>Project Budget</b>	\$564,718
<b>Project Duration</b>	01/01/2003 to 31/12/2006 (Project extended from 01/01/2006 to 31/12/2006)
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

### **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 2 (01/01/2004-31/12/2004)**

This is an action research project concerned with socio-economic change through community-based decision-making where the community of interest involves all the stakeholders in this marketing system. Action research involves the four-phase cycle of research; planning; action; and reflection. During the first year of the project the emphasis was on research (mapping the marketing system) and planning, while in 2004, the emphasis shifted more towards action and reflection.

Development of the physical infrastructure for marketing fresh produce became a major focus of the action taken in 2004. The stakeholders had a particular view about the shape of the infrastructural development. This was the idea of consolidation depots in the major Highland centres (Goroka and Mt. Hagen) with satellite district depots in the production regions serving these consolidation depots. Supporting these new storage and handling facilities would be a well-developed communications infrastructure and transport equipment. In addition, the stakeholder participants viewed it as important that competition exist between buyers at these consolidation and district depots in order that the benefits of the new infrastructure be shared between buyers and sellers.

During 2004, the main action involved:

- publicising the decisions of the planning workshop to different elements of the national government, to various donor agencies and to other relevant parties,

- working with the FPDC to develop and fine-tune the plan for market infrastructure development and
- developing a proposal for funding from donor agencies.

The main avenue for reflection was a steering committee made up of representatives of the marketing system. This committee met three times during the year to review and revise (where necessary) the elements of the action plan.

There were also some research activities that carried over from the first year. These included:

- a survey of supermarket consumers to discover their characteristics and their preferences with respect to fresh produce,
- the development of a proposal for an improved agricultural extension system to support an improved marketing system for fresh produce,
- a survey of women participants in the marketing system to discover what changes can be introduced that would improve their experience, and
- trials with shipments of produce from the Highlands to Port Moresby to discover the weak links in the logistics chain.

Capacity-building of the PNG-based members of the research team took place primarily through the above research activities as well as the co-writing of conference papers and a manuscript for journal publication. We also had a team meeting at the halfway point of the project to reflect on the action research methodology and how this had been implemented in this project. Other capacity-building exercises included: working with the PNG-based members of the research team to develop their work programs (using time management techniques) and conducting a training program (funded separately by ACIAR) for PNG-based research scientists on economics and marketing

## **Project ASEM/2001/055: Improving yield and economic viability of peanut production in Papua New Guinea and Australia using integrated management and modelling approaches**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Leader</b>	Dr Rao C N Rachaputi Phone: 07 4160 0737 Fax: 07 4162 3238 Email: rao.rachaputi@dpi.qld.gov.au
<b>Project Web Site</b>	<a href="http://www.dpi.qld.gov.au/fsi/4354.html">http://www.dpi.qld.gov.au/fsi/4354.html</a> <a href="http://www.dpi.qld.gov.au/fieldcrops/3027.html">http://www.dpi.qld.gov.au/fieldcrops/3027.html</a> <a href="http://www.dpi.qld.gov.au/fieldcrops/6548.html">http://www.dpi.qld.gov.au/fieldcrops/6548.html</a>
<b>Collaborating Institutions</b>	Trukai Industries, Papua New Guinea National Agricultural Research Institute, Papua New Guinea International Crops Research Institute for the Semi Arid Tropics, India Ramu Sugar Ltd, Papua New Guinea
<b>Project Budget</b>	\$593,037
<b>Project Duration</b>	01/07/2002 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

### **Project background and objectives**

Peanut production used to be an important industry in Papua New Guinea (PNG). Production for commercial processing and for export has declined since the late 1980s with the lack of high-yielding varieties, seed supply and cost-effective practices suited to local farming systems all factors. Aflatoxin, a potential health problem, is another as consumption of raw peanuts is common. There is little information on the incidence and extent of contamination of peanuts with aflatoxin in PNG, but studies from similar environments in Indonesia suggest that aflatoxin is likely to be a major problem.

Australia also has some common issues such as drought and aflatoxin contamination — although the peanut industry is more developed than PNG. Australian peanut growers have expressed a need for an economic support package that could help them to make critical decisions about farm management and financial planning. The modelling systems available focus on crop production risks and do not currently incorporate whole farm economic risks. In India, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has a peanut breeding program to produce high-yielding varieties with desirable characteristics, such as large kernel size and tolerance to foliar diseases, for use in developing countries.

The project is developing sustainable practices to improve the yield, quality and economic viability of peanut production in PNG and Australia. This will be achieved by gathering information on peanut production, storage, use, marketing and aflatoxin contamination in PNG, and by developing economics management software for the Australian peanut industry. ICRISAT will participate in the project's activities in PNG.

### **Project progress**

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

*Generate information on peanut production, post-harvest storage, utilisation, marketing systems and extent of aflatoxin contamination:* The report of the peanut farmer survey conducted in four major peanut growing regions (Morobe, EHP, ENB and NCD) has been published by NARI. The aflatoxin survey data base has been updated to include results from January/February samplings. A total of 274 samples were analysed until January 2005. The distribution of aflatoxin contamination (of samples with aflatoxin levels >10 ppb) were in the order of 9 per cent, 27 per cent, 15 per cent and 9 per cent in EHP, ENB, Morobe and NCD regions respectively. Higher frequency and concentration was found in roasted samples followed by dry samples. A comprehensive aflatoxin survey report is under preparation.

*Develop and implement improved varietal and management approaches:* The short and medium duration varietal trials conducted at Aiyura, Bubia and Clear Water sites during the 2005 season were successfully completed. Promising varieties with significant yield advantage over local checks were identified. Storage trials conducted at Aiyura and Clear Water showed that the local practice of storing peanut above fireplaces resulted in a sharp decline in seed viability within three months. Appropriate storage practices to maintain seed viability are needed. Fertiliser trials conducted at Ramu Sugar showed that basal application of lime at 100kg/ha resulted in 48 per cent increase in yields predicting yield and aflatoxin scenarios for Aiyura and Bubia regions.

*Develop a farm economic management software package for Australia:* The development of economic modelling software package "smartpeanut" has been completed. The software package with a suite of farm economic modelling tools has been released to Australian peanut industry stakeholders at a workshop in July at Kingaroy Queensland.

*Training:* Training focussed on peanut experimental techniques, data base management and interpreting APSIM peanut model outputs

*Seed multiplication:* Selected peanut varieties have been initiated at Ramu Sugar with 23 short-duration varieties planted in June 2005. It is expected that the seed material of promising varieties being multiplied at Ramu Sugar will directly feed into farmer participatory "seed village" trials.

*Pest Survey:* The survey data showed: aphids, jassids, pod boring earwigs and wireworms, white grubs (*Lepidiota* spp), and grasshoppers as significant pest constraints. Spiders were the most abundant predators. The peanut mild mottle virus was common and may be associated with jassid pests. Early leaf spot, late leaf spot and rust were also encountered in most sites visited. Verticillium root and stem rot was severe in Eastern Highlands and Kesowai (Madang). Bacterial wilt was suspected in a number of samples but this could not be confirmed. Nutritional deficiency symptoms/disorders in the crops resulting from continuous cultivation of peanut crops was observed.

*Ground Truthing of Satellite Imagery:* Two DigiGlobe high resolution, multi-spectral satellite images of peanut cropping regions in the Upper Makhm Valley of PNG and Wooroolin area of the S. Burnett region of Queensland were acquired. In PNG, during the past few months a number of peanut crops have been identified and GPS locations recorded, and compared remotely sensed crop vigour derived from the multi-spectral satellite image. Subsequent processing of this imagery has indicated that there is good potential to apply this technology for peanut crop monitoring in PNG for potential production forecasting.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Curtin University of Technology, Australia
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<b>Collaborating Institutions</b>	Cocoa and Coconut Research Institute, Papua New Guinea Oil Palm Research Association, Papua New Guinea PNG Cocoa & Coconut Extension Agency, Papua New Guinea
<b>Project Budget</b>	\$572,693
<b>Project Duration</b>	01/07/2003 to 31/12/2006 (Project extended from 01/07/2006 to 31/12/2006)
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

**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 2 (01/07/2004-30/06/2005)**

Improve the capacity of research and extension services in the cocoa and coconut industries:

Smallholder interviews and surveys examining production and productivity were completed in June 2004. The initial findings demonstrated that labour shortages and inadequate management of cocoa blocks, especially pruning and shade control, are major constraints on production. Attention has shifted towards understanding the complex relationships between the supply of smallholder household labour, farm management practices and pest and disease problems, through cocoa block management surveys to complement the smallholder interview data collected earlier in the project.

A pest and disease survey of 98 cocoa blocks at two villages on the Gazelle Peninsula revealed very low levels of block maintenance and high pest and disease rates. Almost half of the blocks were weeded adequately or better, although a substantial proportion were less than adequately pruned (76 per cent) or managed for shade (72 per cent). Mature cocoa blocks are typically characterised by the tall and dense growth of cocoa trees under a heavy shade canopy. Farm visits and smallholder interviews also revealed that most of the slashing of weeds and grasses on cocoa blocks occurs at the beginning of the cocoa flush period.

The cocoa block surveys and farm visits also indicate that pest and disease management is minimal, despite the widespread recognition of pest and disease problems amongst growers. The two major known diseases of cocoa in PNG, Vascular Streak Disease and Canker, were common with only 8 per cent and 26 per cent of trees, respectively, being free of these diseases. Considerable evidence of under-harvesting was also found in the cocoa block surveys, as indicated by a relatively high incidence of dry pod (29 per cent of full size pods).

Interview data together with general observations and data derived from the block management surveys suggest that the age of a cocoa block is a key determinant of block condition, household labour inputs and the harvesting strategies of smallholders: together they influence smallholder block productivity. Because of a lack of pruning and shade control, many cocoa blocks move prematurely into an unproductive stage where the block is overgrown and production is very low. Despite recent increases in yields per hectare obtained from new high yielding cocoa material, the results of the study demonstrate that there remains considerable potential for further rises in smallholder productivity without the need to expand the area under cultivation.

*Evaluate OPIC's Mobile Card trial at Hoskins for potential introduction to other smallholder oil palm areas:* The evaluation of the Mobile Card trial at Hoskins indicated very positive socio-economic benefits for smallholders. Work commenced to introduce and test the Mobile Card amongst oil palm smallholders at the Bialla scheme in West New Britain Province.

*Introduce and test in the smallholder cocoa sector proven payment systems:* As there are numerous competing buyers in the cocoa industry it is more difficult to establish these new payment mechanisms than in the oil palm industry where a single buyer services each region. Discussions with key stakeholders in the cocoa industry indicate that the introduction of any new smallholder payment schemes to raise productivity would need to be established in areas near centralised processing facilities such as nucleus estate arrangements, or where a single company or buyer/processor dominates a particular district or village.

In the initial stages of the research we concentrated on Bailu Estate near Kokopo, East New Britain (ENB), where a large plantation estate had been returned to the customary landowners. Work is now concentrating on three other private sector nucleus estate models that have been developed for cocoa. The first is in the remote Bainings region of ENB and is managed by Agmark (the largest cocoa buyer in Papua New Guinea); the second at Tokiala on the Gazelle Peninsula, also managed by Agmark; and a small village-based company near Kokopo — Bitagalip holdings.

The Agmark model is similar to the traditional nucleus estate model with the company buying cocoa from smallholders surrounding the company plantation. Agmark provides extension services, planting material and other support. The team completed an evaluation of the Agmark model at Stockholm in the Bainings, ENB, and began work at Tokiala. The latter evaluation will run from September 2005 to February 2006 and involves smallholder surveys and interviews with the 38 leaseholders making up the Tokiala land settlement scheme.

The village based model at Bitagalip is progressing more slowly because the service provider has much less resources than Agmark. Approximately 60 smallholders sell wet bean to the village service provider and smallholders are receiving support for block rehabilitation. Although still in its early days, this village model is proving relatively successful. CCI project staff have provided training and assisted the service provider to establish a nursery of hybrid cocoa and a budwood garden for hybrid clones. A replanting program has been initiated and is well under way.

While the first two Agmark models are similar, in that a major company is buying cocoa and supplying services to smallholders, the third is very different because the service provider is from the same village as the smallholders. Both models offer promising opportunities for the introduction and testing of new payment mechanisms.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Australian National University, National Centre for Development Studies, Australia
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<b>Collaborating Institutions</b>	National Fisheries Authority, Papua New Guinea
<b>Project Budget</b>	\$269,486
<b>Project Duration</b>	01/07/2003 to 30/06/2006
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

### **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 metric 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 Fishing 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, and
- assess the impact of a small boat (inshore) fishery on the Gulf of Papua prawn fishery.

### **Project progress**

#### **Year 2 (01/07/2004–30/06/2005)**

Based on the generic form of the bioeconomic model constructed last year in the project, a mathematical form and computer coding are now complete. Key project personnel are now thoroughly familiar with its construction and implementation.

Most of the economic data required to calibrate the bioeconomic model for the case of the GPPF has been assembled and verified. Industry cooperation with data access has been very beneficial. Final bioeconomic model results are now pending the final inclusion of the stock assessment model.

A joint meeting (combining the economics aspects of this and a related biology project) to coordinate research and data collection was held in PNG in October 2004. At this meeting project objectives were discussed, including ongoing reports on the extent and availability of data collection, with working groups reporting on stock assessment and vessel characteristics research. A meeting with industry also took place.

A final version of the bioeconomic model — as applied to the specific case of the GPPF — was developed, finalised and coded. All relevant economic data was collected from industry and through port visits throughout the year, allowing sufficient calibration of the bioeconomic model in terms of its major economic components. Considerable progress was made on the development of management objectives and policy options for the GPPF.

## **Project ASEM/2003/010: Farmer evaluation and multiplication of sweet potato varieties on the North Coast of PNG**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	World Vision Australia, Australia
<b>Project Leader</b>	Mr John Donnelly Phone: 03 9287 2233 Fax: 03 9287 2377 Email: John_donnelly@wvi.org
<b>Collaborating Institutions</b>	Australian National University, Australia World Vision Trust Pacific Division, Papua New Guinea National Agricultural Research Institute, Papua New Guinea
<b>Project Budget</b>	\$795,937
<b>Project Duration</b>	01/04/2004 to 31/03/2007
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

### **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 the likelihood of finding varieties that are more suitable to localised conditions, offering yield boosts, high.

NARI has collected and trialled many crops and varieties that are likely to benefit farmers facing 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, a reserve against drought and other disasters that often strike these areas. By evaluating and disseminate appropriate sweet potato varieties to the rural farming sector along the north coast of PNG the project is working to meet this potential.

### **Project progress**

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

The initial 16 varieties to be used for the trials were transported to the National Agriculture Research Institute (NARI)-Bubia from Kerevat and multiplied for the project. Training to support these trials was also conducted, boosting capacity at NARI. This included hands on-training in reading and interpreting field layouts, squaring of trials sites and establishment and preparation of sites.

Planting of the first phase of the multiplication started in November 2004. All data collection for this phase was completed in January 2005 and site selection, land preparation then planting of the second phase multiplication took place in February 2005. The second phase multiplication was to obtain sufficient material for the Technician Controlled on-farm trials (TCOFT). The project has now started with the planting of the first TCOFT and will complete the planting by May 2005. Fourteen researcher varieties and two farmer varieties are being used in the TCOFT.

Key elements of TCOFT activities will include:

- the use of two standard farmer varieties,
- delaying of the taste panel from the multiplication phase to ensure that enough planting material is available,
- a reduction of the number of trial sites from 10 per multiplication site to six, resulting in the total of 72 trial sites and not 120 to allow better supervision of all sites,
- increasing the number of varieties to be tested from five to 16 so that farmers have ample opportunity to evaluate all 16 varieties,

- using one guard-row around the whole trial rather than one around each variety to reduce the amount of area required, and
- conducting a 'time of harvest' trial to establish the optimal time of harvest as varieties mature at different times.

The project has also had visits from the management of World Vision in Port Moresby with the Program coordinator making several visits. Visitors also included staff from Queensland Department Primary Industries (QDPI) and NARI as reported elsewhere in the report and Dr. Ken Menz of ACIAR who visited our Dumpu and Rai Coast High school sites in March together with Dr. Henderson. During the visit by the team from QDPI and ACIAR, the Madang Agriculture, Livestock and Fisheries (ALF) Chief and his assistant were present and visited all sites including Dumpu and Rai Coast High school. To date the World Vision FE&MSP project has a total of 4 motorbikes, a bicycle, a 19 ft speedboat and a 40HP motor.

## **Project ASEM/2004/011: Evaluating domestic tuna fisheries projects**

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	University of Queensland, School of Economics, Australia
<b>Project Leader</b>	Professor Harry Campbell Phone: 07 3365 6570 Fax: 07 3365 7299 Email: h.campbell@economics.uq.edu.au
<b>Collaborating Institutions</b>	National Fisheries Authority, Papua New Guinea Forum Fisheries Agency, Solomon Islands
<b>Project Budget</b>	\$331,431
<b>Project Duration</b>	01/04/2005 to 31/03/2008
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

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

### **Project progress**

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

The first progress report is due in 2006.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Curtin University of Technology, Agribusiness Marketing, Australia
<b>Project Leader</b>	Dr Peter Batt
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<b>Collaborating Institutions</b>	PNG Coffee Industry Corporation, Papua New Guinea
<b>Project Budget</b>	\$391,571
<b>Project Duration</b>	01/04/2005 to 31/03/2007
<b>ACIAR Research Program Manager</b>	Dr Ken Menz

**Project background and objectives**

The global reputation of Papua New Guinea's (PNG) coffee was built on quality supply from the estate sector, (block owners and plantations). But today the estate sector has declined in both quality and output, with smallholder farmers producing 85 per cent of total production. The reputation of PNG coffee has coincided with the decline of the estate sector. Unfortunately the perception of world markets of the product delivered is now one of low quality. Some producers and processors in PNG's highlands have begun to develop marketing arrangements to improve quality throughout the whole supply chain. Analysing these schemes should reveal the extent to which it is possible to facilitate the extension of, and replication of, successful initiatives beyond those now in use.

**Project progress**

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

The first progress report is due in 2006.

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

<b>Overseas Collaborating Countries</b>	Indonesia, Papua New Guinea, Philippines, Vietnam
<b>Commissioned Organisation</b>	University of Queensland, School of Land and Food, Australia
<b>Project Leader</b>	Dr Steve Adkins Phone: 07 33652072 Fax: 07 33651177 Email: s.adkins@mailbox.uq.edu.au
<b>Collaborating Institutions</b>	Philippine Coconut Authority, Philippines Cocoa and Coconut Research Institute, Papua New Guinea Research Institute for Coconut Palms, Indonesia University of the Philippines at Los Banos, Philippines Oil Plants Institute of Vietnam, Vietnam
<b>Project Budget</b>	\$805,329
<b>Project Duration</b>	01/07/2002 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Mr John Cullen

### **Project background and objectives**

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

The worldwide production of coconut has not increased in decades. The lack of new genetic stocks and the devastation of crops from several major pests and diseases have kept yield slower than expected. Coconut producing countries have also experienced a rapid loss of important coconut germplasm due to their inability to collect and conserve precious germplasm.

Few of the coconut producing countries have the capacity to characterise and evaluate the field performance of conserved germplasm. Many of these countries also lack the capacity to exchange disease-free germplasm with other coconut producing countries because they are unable to undertake embryo culture, they do not have a capability to index diseases and their germplasm export clearances are tedious.

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

All the coconut biotechnological techniques that will be gained from this project will be transferred to the partner countries in this project (Papua New Guinea, the Philippines, Indonesia and Vietnam).

### **Project progress**

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

The physiological quality of the embryo used for tissue culture work is an important factor that, in part, determines the rate of seedling production from those embryos. Recent studies have shown that bigger embryos produce more healthy seedlings than the smaller ones. The efficiency of the embryo culture system has been further improved with a step that screens out all of the non-viable embryos from the tissue culture system after 6 to 10 weeks of culture. Reducing the medium carbohydrate load at the last seedling subculture step has been shown to have no negative effects on its subsequent

growth but this action does reduce the chance of the seedlings becoming infected and performing poorly at a later stage of growth. Auxins applied at various times during the early steps of the embryo culture procedure were found to increase root production and this resulted in greater ex vitro seedling vigour. Removal of the haustorial tissue during the early steps of embryo culture was also able to improve seedling growth and ex vitro establishment. A simple acclimatization method, using a wooden box with a transparent plastic sheet lid, produced better quality seedlings than those produced using the traditional inverted plastic bag system presently used for seedling production.

Other results have shown that as early as 3 months into the in vitro culture procedure seedlings are capable of autotrophic growth if their roots are able to access a Hoaglands nutrient solution. However, the subsequent growth of these nutrient-nurtured seedlings was often slower than that seen for seedlings growing in the traditional way. Finally, CO<sub>2</sub> enrichment around young seedlings growing in nutrient solution, could promote seedling growth back to that seen in the control. This action was able to cut the time in vitro from 12 to about 3 or 4 months. This represents a massive saving in culture cost and time. Earlier work demonstrated that embryo transplantation is a possible method for producing seedlings from isolated embryos using surrogate nuts as nurturing hosts. This work, undertaken in Australia on poor quality supermarket nuts is now being repeated using quality fruit and embryos in Indonesia (ICOPRI). At this stage, there has been some difficulty in germinating the transplanted embryos in the surrogate host nuts with contamination hard to contain. A seed priming method is now being used to promote the germination of the transplanted embryo. At this stage >200 primed embryos of Palu Tall have been transplanted into either Mapanget Tall or Palu Tall.

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

A protocol to test the genetic fidelity of plants coming from tissue culture has now been developed and used to study 20 clonal plants. Results indicate that the clones analysed in this project are genetically similar at the DNA nucleotide and methylation level following their production by somatic embryogenesis. Training was undertaken at UQ attended by three participants: from PNG, Dr. Pablito the Philippines and Vietnam. The training covered all of protocols used in all of the research programs of the project, with an emphasis placed on those used in the embryo culture program particularly the use a CO<sub>2</sub> fogging step to improve physiological health and growth of in vitro growing seedlings prior to their establishment in soil. Other training activities were also undertaken at OPI, ICOPRI Indonesia and PCA the Philippines.

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

<b>Overseas Collaborating Countries</b>	Fiji, Papua New Guinea, Samoa
<b>Commissioned Organisation</b>	Queensland University of Technology, Centre of Molecular Biotechnology, Australia
<b>Project Leader</b>	Associate Professor Rob Harding Phone: 61 7 3864 1379 Fax: 61 7 3864 1534 Email: r.harding@qut.edu.au
<b>Collaborating Institutions</b>	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
<b>Project Budget</b>	\$1,576,307
<b>Project Duration</b>	01/07/1998 to 30/06/2006 (Project extended from 01/07/2001 to 30/06/2006)
<b>ACIAR Research Program Manager</b>	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 underway as the first step to developing sensitive specific tests for each virus.

### **Project progress**

#### **Year 5 (01/11/2003-31/10/2004)**

*Characterisation of taro viruses and development of diagnostics:* Following characterisation of genetic elements investigation of the sequence variability in the genome of isolates from PNG, Solomon Islands, New Caledonia and Vanuatu TaRV in order to develop a more specific PCR test was conducted. Based on this data, a specific PCR-based diagnostic assay for this virus has now been developed.

A diagnostic PCR test for Taro vein chlorosis virus (TaVVCV) has now been developed for this virus following genetic sequencing work on a Fijian TaVVCV isolate. To help in diagnosing the Colocasia bobone disease virus (CBDV) a PCR-based diagnostic has been developed based on characterising

a genetic region of a PNG isolate. Preliminary characterisation and analysis studies on TaBV-like sequences have indicated that the TaBV-like sequences present in taro are integrated sequences.

The characterisation of TaRV and the two rhabdoviruses has enabled the subsequent development of sensitive diagnostic tests for these viruses. As such, diagnostic 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. This 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:* One hundred and fifty-nine taro lines have been indexed for each of the taro viruses according to an internationally-recommended schedule. Safe international transfer of indexed taro germplasm will 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 were DNA fingerprinted using radio-labelled SSR (Simple Sequence Repeat) markers. Entire collections from Fiji, Samoa, Tonga, Niue, Palau, Cook Islands were fingerprinted. A 20 per cent 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.

From the overall collection of 2206 accessions, 527 were DNA fingerprinted with SSR markers to assess taro genetic diversity within and between countries, 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 the Solomons. Evidence from this study and that of the EU-TANSO study suggest that there are two centres of diversity, one in PNG/Solomons and the other in Indonesia/Malaysia. These should be seen as major sources of future genetic diversity for genetic improvement programs.

*Rationalisation of taro germplasm to form a core collection:* Based on DNA fingerprints a core collection for each country was selected. The aim of the core collection is to reduce the size of the collection to about 10 per cent of the total accessions while attempting to maintain at least 85 per cent of the genetic diversity available, which can then be conserved more easily and utilized more effectively. The core collection is stored as *in vitro* tissue cultures, primarily at the Regional Germplasm Collection 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 underway to maintain a duplicate collection in PNG.

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

<b>Overseas Collaborating Countries</b>	Indonesia, Papua New Guinea, Philippines
<b>Commissioned Organisation</b>	Queensland Department of Natural Resources and Mines, Australia
<b>Project Leader</b>	Dr Michael Day Phone: 07 3375 0725 Fax: 07 3379 6815 Email: Michael.Day@nrm.qld.gov.au
<b>Collaborating Institutions</b>	Universitas Nusa Cendana, Indonesia SEAMEO Regional Centre for Tropical Biology, Indonesia National Agricultural Research Institute, 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
<b>Project Budget</b>	\$1,055,012
<b>Project Duration</b>	01/07/1997 to 30/09/2006 (Project extended from 01/01/2002 to 30/09/2006)
<b>ACIAR Research Program Manager</b>	Dr T K Lim

### Project background and objectives

Siam weed (*Chromolaena odorata*) 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, which 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 is to enhance the biological control of Siam weed (*Chromolaena odorata*) in Indonesia, Papua New Guinea and the Philippines. The work continues 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 progress

#### Year 5 (01/01/2004-31/12/2004)

The reporting and recording of new chromolaena infestations within PNG continued, with 56 previously unreported infestations being found. There were new infestations found in all provinces where chromolaena had been previously reported. In addition, there was an unconfirmed report of

chromolaena in Central Province by NAQIA. Public and provincial awareness of chromolaena continues to increase, though there is concern that due to the large number of new sites each year, there may still be large areas where chromolaena is present but not reported. Chromolaena has now been found in 199 sites, covering 12 provinces. In some provinces such as New Ireland where 18 new sites were reported, the weed is still spreading along roadsides and in the islands.

The gall fly *Cecidochara connexa* continues to be field-collected from various sites in the Markham Valley, Morobe Province and released in other provinces. Over 27,000 galls were released at 70 sites in 11 provinces over the past year. The fly has now been released in 11 provinces, with only North Solomons still to receive galls. The fly has established at 63 sites in 11 provinces and field populations are increasing and spreading in most areas where the fly has established. At many sites over 20 galls per plant are being recorded and flies have spread up to 30 kms covering an additional 40 new sites. The impact of the gallfly is being monitored. In New Ireland, plants have been killed by the fly and villagers are moving the fly around to new areas. The fly is also reducing chromolaena infestations in Sandaun province. In Morobe where conditions are generally drier, the number of galls per plant is still increasing and plant density appears to be decreasing. Several sites are being monitored in detail.

The rearing and release of the moth *Pareuchaetes pseudoinsulata* ceased in early 2004. The moth proved difficult to rear and very labour-intensive. The moth was released in nine provinces but has only established in Morobe Province, where it has been found at 13 sites. Damage at some sites in the Markham Valley has been significant, with plants being severely defoliated on a seasonal basis.

An application to import a third agent, the leaf-mining fly *Calycomyza eupatorivora* from South Africa was approved and the insect was imported twice during 2004. However, a viable colony was not able to be established and the colony died out on both occasions. The insect will be imported again in 2005.

An application to import the stem-boring beetle *Lixus aemulus* has been submitted to NAQIA and DEC and a decision is pending.

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

<b>Overseas Collaborating Countries</b>	Indonesia, Papua New Guinea, UK
<b>Commissioned Organisation</b>	Bureau of Sugar Experiment Stations, Australia
<b>Project Leader</b>	Dr Robert Magarey Phone: 07 4068 1488 Fax: 07 4068 1907 Email: rmagarey@bses.org.au
<b>Collaborating Institutions</b>	Indonesian Sugar Research Institute, Indonesia Ramu Sugar Ltd, Papua New Guinea Australian Quarantine Inspection Service, Australia Institute of Arable Crops Research, UK
<b>Project Budget</b>	\$1,000,564
<b>Project Duration</b>	01/07/2000 to 30/06/2006 (Project extended from 01/07/2004 to 30/06/2006)
<b>ACIAR Research Program Manager</b>	Dr T K Lim

### **Project background and objectives**

Sugar cane (*Saccharum* species) is an important tropical crop both in Australia and in the wider region. The centre of origin of the genus is the island of New Guinea, which contains a rich diversity of germplasm.

Several serious diseases and pests of *Saccharum* occur in Irian Jaya and Papua New Guinea (PNG) but not in the rest of Indonesia or in Australia. Conversely, some diseases occur elsewhere but not in Irian Jaya or PNG. The various pests and diseases pose a great threat to commercial sugar production in all three countries, and especially worrying is their movement into new areas. Knowledge of the distribution of the pathogens and pests is still very scant and, in some cases, so are the details of their ecology.

However, the germplasm within the island of New Guinea is likely to be useful in counteracting the problems faced by commercial growers, as long as it can be used without bringing its pathogens with it. At an international conference on sugarcane quarantine and germplasm exchange in Brisbane in 1995, it was agreed that research was urgently needed on conserving *Saccharum* germplasm and on minimising the threats from its pests and diseases - which would include increased awareness of quarantine and more effective quarantine.

This project will therefore survey the distribution of pathogens and pests across the region, research the ecology and possible control measures for these biological threats, and provide the necessary lab equipment and training to improve research skills and quarantine operations in the region.

The aim of the project was to study the pests and diseases of sugar cane, and to improve quarantine operations and the skills of researchers and quarantine officers in Australia, Indonesia and PNG.

### **Project progress**

#### **Year 5 (01/07/2004-30/06/2005)**

Activities in the project for the last 12 months have included strategic surveys. In November 2004, a survey to East New Britain was conducted in order to collect further information (and samples) related to an unusual type of sugarcane mosaic. A previous survey had found this disease at Kerevat. The unusual mosaic was again located in a collection of *S. edule* at the NARI Research Station, but nothing was found in surrounding villages and in roadside 'wild' *Saccharum* species. Samples assayed at the BSES DNPRC facility failed to identify the known viral pathogens causing sugarcane mosaic, sorghum mosaic or streak mosaic diseases. There remains a need for further research to identify the causal agent of this PNG mosaic. This will be partly progressed during the life of the

project but studies to specifically address determining the nature of the causal agent were not specified project objectives. A 12 day survey of east Java also sought to determine the causes of sugarcane mosaic symptoms in the Indonesian sugar industry. Collected and assayed samples highlighted the presence of several of the mosaic viral pathogens. The results will be discussed further with Indonesian scientists. A 5 day survey of sugarcane growing in Cape York tip communities was undertaken to determine the distribution of the vector for Ramu stunt – *Eumetopina flavipes*. The opportunity was taken to introduce a PhD student (an AQIS employee) to the pest. Her work, funded by SRDC, will greatly assist our understanding of the insect and the potential to eradicate the pest from the Australian mainland.

Research into the causal agent of Ramu stunt has been continuing and there is further evidence for the involvement of a virus as the causal agent. Research has identified a specific band in viral minipreps and a 36KDa protein in diseased but not healthy leaves. Small (isometric) spherical particles have been seen under an electron microscope in diseased tissue. This offers a solid lead in the identification of the causal agent.

Elisa equipment is in the process of being purchased for Ramu Sugar. The Ramu pathologist, who will be responsible for the assay procedure, visited BSES laboratories in May 2005 for further training in the assay procedure.

Ramu-bred varieties have entered quarantine so they can be sent to CIRAD (France) for transfer into tissue culture. This will enable them to be sent to the Indonesian Sugar Research Institute for smut resistance screening.

During the surveys undertaken in PNG, Indonesia and northern Australia, the opportunity was taken to speak to, and assist, quarantine officers and ACIAR scientists in the identification of sugarcane pests and diseases. Our visits again raised the awareness of sugarcane quarantine with these officers. Some training was also undertaken in association with an SRDC-funded project that aims to interact and train Australian quarantine staff (project leader is Mohamed Sallam from BSES). Staff visited BSES Meringa and observed the different *Saccharum* species found in remote parts of Australia and PNG. Presentations were also made on both endemic and exotic pests and diseases of sugarcane.

## Project CP/2001/032: Impact and management of *Oribius* weevils in Papua New Guinea

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Queensland University of Technology, Australia
<b>Project Leader</b>	Dr Anthony Clarke Phone: 07 3864 5023 Fax: 07 3864 1535 Email: a.clarke@qut.edu.au
<b>Collaborating Institutions</b>	National Agricultural Research Institute, Agricultural Research Division, Papua New Guinea Fresh Produce Development Company Ltd., Crop Protection Programme, Papua New Guinea
<b>Project Budget</b>	\$336,045
<b>Project Duration</b>	01/07/2002 to 31/12/2005 (Project extended from 01/01/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr T K Lim

### Project background and objectives

*Oribius* weevils occur in Papua New Guinea, Irian Jaya and far north Queensland. They are a major agricultural pest in PNG, attacking the leaves, young shoots and developing fruits of a wide range of crop plants. Loss of plant vigour and surface scarring of fresh produce can reduce crop yields by 50–100 per cent.

At present there is almost no information on *Oribius* weevils. It is known that adults rather than larvae cause the damage to plants, but little is known about their status, systematics or ecology. The project is estimating the impact of *Oribius* weevils on fruit and vegetable crops in Papua New Guinea (PNG), by obtaining information on *Oribius* systematics and ecology, to help develop methods to control infestations of these weevils.

### Project progress

Year 2 (01/07/2004–30/06/2005)

#### *Biological and economic impacts*

An extensive farmer-based crop impact survey was undertaken in Eastern Highlands Province, with leaf and fruit damage estimates obtained from individual growers throughout the region. Surveys were based on a relative damage scale (High, Medium and Low). Farmers recognised some level of oribius damage on all but three of the crops surveyed. However, relatively few farmers scored oribius damage as high. We suspect, based on our experimental studies, that farmers underestimate the impact of oribius on crop yield. For example, cabbage was originally included in our earlier impact trials simply because of its regional importance, but no local stakeholders considered it to be subject to oribius attack. Nevertheless, our formal trials subsequently showed a 30% improvement in yield when the crops were protected.

#### *Ecology*

Preliminary studies on the use of biological barriers and intercropping techniques yielded mixed results. Spring onion and highland pit barriers reduced the numbers of *Oribius* invading and feeding on crop. Spring onion intercropping also reduced damage and colonisation levels significantly.

#### *Insecticides*

Field validation studies were undertaken for the two most effective insecticides identified in laboratory trials. Twenty-four trial plots with 20 capsicum plants in each were constructed so that each insecticide had three ¼ dose plots, three ½ dose plots, three full dose plots and three control plots. Plots were sprayed on a need basis, with all fruit collected and weighed progressively throughout the season.

Overall results of spray trails suggest that use of either Karate or Target at ¼ manufacturer's concentration will significantly increase yield. The lower cost of Karate and its extra efficacy in the field should make it the chemical of first choice. Costs associated with the control strategy are easily compensated for by the significant increase in yield.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Leader</b>	Dr Bruno Pinese Phone: 07 40484666, 07 40484600 Fax: 07 40923593 Email: bruno.pinese@dpi.qld.gov.au
<b>Project Web Site</b>	<a href="http://www.dpi.qld.gov.au">http://www.dpi.qld.gov.au</a>
<b>Collaborating Institutions</b>	Department of Agriculture, Fisheries and Forestry, Australia National Agricultural Research Institute, Papua New Guinea National Agriculture and Quarantine Inspection Authority, Papua New Guinea
<b>Project Budget</b>	\$357,290
<b>Project Duration</b>	01/07/2003 to 30/06/2006
<b>ACIAR Research Program Manager</b>	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 progress**

#### **Year 1 (01/07/2003–30/06/2004)**

Project related activities to study the red banded mango caterpillar (RBMC) have commenced in Papua New Guinea; near Port Moresby and in East New Britain. Facilities were upgraded and, scientific equipment needed to conduct pest biology studies was purchased and sent to Kilakila and Keravat. Technical staff were recruited and employed. Two vehicles were purchased to allow regular visits to experimental sites and equipment purchased to carry out laboratory and field studies.

Data on pest incidence on mango fruit from a number of locations in the Port Moresby and East New Britain areas was undertaken from November 2003 and continued to end of the fruiting season in February 2004. This data confirmed the severity of this pest with fruit losses averaging 55 per cent and ranging from no loss to 100 per cent at different locations. All mango cultivars were attacked including Kensington pride which suffered losses of 50 per cent. This indicates that the RBMC has the potential to be a serious pest of commercial and non commercial mango in Australia where Kensington Pride is the most important commercial cultivar.

Monitoring for adult moth emergence periods, egg laying period and start of fruit damage is underway. Obtaining information on alternative host fruits and the duration of life cycles will also aid in developing controls. Field collection of larvae to provide pupae for pheromone studies and chemical and cultural field control studies have also begun.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Department of Primary Industries, Victoria, Knoxfield Centre, Australia
<b>Project Leader</b>	Rudolf De Boer Phone: 03 9210 9222, mobile 0408 592 051 Fax: 03 9800 3521 Email: dolf.deboer@dpi.vic.gov.au
<b>Collaborating Institutions</b>	CRC for Tropical Plant Protection, Australia International Potato Centre, 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
<b>Project Budget</b>	\$918,109
<b>Project Duration</b>	01/11/2004 to 31/10/2009
<b>ACIAR Research Program Manager</b>	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, and
- developing safe and cost effective integrated late blight management strategies for existing and new potato cultivars

### **Project progress**

#### **Year 1 (01/11/2004–31/10/2005)**

The first progress report is due late in 2005.

**Project CP/2004/001: TaroPest: A computer based information and diagnostics package for taro pests of the South Pacific**

<b>Overseas Collaborating Countries</b>	Fiji, Papua New Guinea
<b>Commissioned Organisation</b>	Queensland University of Technology, School of Natural Resource Sciences, Australia
<b>Project Leader</b>	Dr Anthony Clarke Phone: 07 3864 5023 Fax: 07 3864 1535 Email: a.clarke@qut.edu.au
<b>Collaborating Institutions</b>	Secretariat of the Pacific Community, Fiji National Agriculture and Quarantine Inspection Authority, Papua New Guinea
<b>Project Budget</b>	\$368,534
<b>Project Duration</b>	01/07/2004 to 31/12/2006
<b>ACIAR Research Program Manager</b>	Dr T K Lim

### **Project background and objectives**

Taro is culturally and economically important in the South Pacific. Culturally it is a staple food, important to food security and as a 'prestige' crop with a role in gift giving and ceremonial activities. Economically it generates substantial returns (in Fiji FJD\$1.85 billion) and creates flow on benefits such as employment and income in rural areas. Taro is also important as an export industry in some Pacific Island countries. Where exporting occurs facilities for packing and shipping can provide jobs, a valuable avenue out of poverty. The main barriers to productivity are pests and diseases. More than 130 pests and diseases have been recorded in the SPC Plant Protection Service database. Many of these cause minor crop losses, but a few can devastate crops, such as leaf blight in Samoa in 1993 which virtually eliminated taro. The majority of pests and diseases are present in only a few countries. This makes the introduction of these to other countries, as in the case of Samoa above, all the more devastating.

The exporting and trade of taro increases the risks of diseases and pests spreading. Quarantine agencies in the region have an important role to play in ensuring this spread is stopped. Diagnostic expertise for quarantine officers, extension workers, farmers and some scientists is lacking. A comprehensive package is needed to help the range of people involved in taro farming, trade and research better manage pest and disease diagnosis. The project will:

- produce a diagnostic and information package for taro pests and diseases of the South Pacific,
- enhance regional capacity in the ability to build and use Lucid based information and diagnostic packages, and
- test and incorporate user feed-back and dissemination of *TaroPest* to end users.

### **Project progress**

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

The first progress report is due in 2005.

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

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Leader</b>	Dr Mike Rimmer Phone: 07 4035 0109 Fax: 07 4035 6703 Email: Mike.Rimmer@dpi.qld.gov.au
<b>Collaborating Institutions</b>	Secretariat of the Pacific Community, New Caledonia WorldFish Center, New Caledonia
<b>Project Budget</b>	\$762,855
<b>Project Duration</b>	01/01/2004 to 31/12/2006
<b>ACIAR Research Program Manager</b>	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 seacucumber, 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, and
- extending the outcomes of completed and ongoing ACIAR and Worldfish projects to other communities / countries in the Pacific Islands and northern Australia.

### **Project progress**

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

*Mini-projects:* During the first year, four mini-projects were approved and funded. Two have commenced, the others will start in 2005:

- *Confirmatory testing of the viral status of Penaeus monodon (black tiger shrimp) populations in the Fiji Islands.* This small miniproject commenced in June 2004 and was due to finish in November 2004 but has been extended to February 2005. An interim report is presented in Appendix 1.
- *Development of commercial and farm-made feeds for tilapia and macrobrachium in PNG and Fiji.* This project is a large miniproject which commenced in December 2004 and is due to finish in August 2006.
- *Monoculture of the freshwater prawn, Macrobrachium lar, in Vanuatu and integrated prawn-taro farming in Wallis & Futuna.* This small miniproject is due to commence in February 2005 and run for approximately six months.

- *Rehabilitation of the mariculture research facility at Motupore Island Research Centre, Papua New Guinea.* This small miniproject is also due to commence in February 2005 and be completed by April 2005.

*Capture and culture of pre-settlement coral reef fishes and invertebrates:* This component of the project is continuing the activities of a related ACIAR project developing new artisanal fisheries based on the capture and culture of postlarval coral reef fish (referred to as PCC), using WorldFish staff based at the Nusa Tupe Field Station, Solomon Islands. In June a workshop to train village participants and National Fisheries Officers in PCC techniques was held at Nusa Tupe. As a result of the training received, community members from two Western Province villages began catching and rearing post-larval lobster, cleaner shrimp and fish. Several shipments have been made to the Honiara-based aquarium fish exporter between October and December, generating income of SB\$3,750 (approx. AUD 750).

In November the project team visited the towns of Buala and Kia in Isabel Province to raise awareness and gauge interest in transferring the technology to another area in Solomon Islands. As a result of the presentation given at the Fourth Heads of Fisheries Meeting in Noumea in August 2004 several Pacific countries have expressed an interest in adopting the PCC technology. Progress was made in the preparation of a simple methods manual for the techniques. A Solomon Island artist has been engaged and a number of draft illustrations submitted.

*Sea cucumber aquaculture/reseeding:* Sandfish (*Holothuria scabra*) hatchery production is being undertaken at the hatchery facility of QLD DPI&F Northern Fisheries Centre, Cairns. Initially, only broodstock acquisition and maintenance was scheduled for the first year of the project. However, two successful hatchery runs were also completed in late 2004, which brought forward the production aspect of this component.

Broodstock were purchased from the Nunukul Ngugi Cultural Heritage Corporation of Stradbroke Island who operate a developmental fishery in Moreton Bay. In May 2004, 123 mature sandfish were transferred to a pond at DPI&F Oonoonba Veterinary Laboratory (OVL). In order to compare the performance of different ponds with respect to broodstock maintenance, 60 sandfish were moved to a commercial shrimp pond in July 2004. In late 2004, 47 sandfish remained in the OVL pond and were used for hatchery production.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	University of Western Sydney, Australia
<b>Project Leader</b>	Dr Paul Smith Phone: 02 46203329 Fax: 02 46203025 Email: pt.smith@uws.edu.au
<b>Collaborating Institutions</b>	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
<b>Project Budget</b>	\$774,747
<b>Project Duration</b>	01/01/2005 to 31/12/2008
<b>ACIAR Research Program Manager</b>	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 do not have a high number or diversity of species to support these needs. Farming of fish, or Aquaculturing, is one avenue through which increased supply can be reached. 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 6,000 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 aquaculturing fish.

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

The first progress report is due early in 2006.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	CSIRO Marine and Atmospheric Research, Australia
<b>Project Leader</b>	Professor Neil Loneragan Phone: 08 9360 6453, mob: 0419 950 034 Fax: 08 9360 6303 Email: n.loneragan@murdoch.edu.au
<b>Collaborating Institutions</b>	National Fisheries Authority, Papua New Guinea University of Tasmania, Australia
<b>Project Budget</b>	\$479,680
<b>Project Duration</b>	01/07/2003 to 31/12/2006 (Project extended from to 31/12/2006)
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

The Gulf of Papua Prawn Fishery is one of Papua New Guinea's (PNG) most important fisheries. It provides a total annual catch of about 1000 metric tonnes, worth K\$10 million. Fishing in the Gulf is overseen by the National Fishing Authority (NFA), who recently allocated 10 new licenses for a small inshore prawn fishery. Little is known about the potential biological and economic impacts of the uptake of these licenses. 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 examined management of the prawn fisheries. This 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 have established a basis for assessment in this new project, that will develop and evaluate management strategies and policies for the profitable and biologically sustainable utilisation of the Gulf of Papua prawn resources. This will involve an assessment of the biological status and impact of varying fishing strategies and levels of effort on prawn resources, along with the potential impact of a small boat (inshore) fishery on the "offshore" fishery.

### **Project progress**

#### **Year 2 (01/07/2004–30/06/2005)**

NFA project staff continued to work on updating the NFA logbook database. Daily logbooks from 2001 onwards were entered and historical records from 1975 — 1999 were retrieved from the government archives and began to be entered. Thus, a larger data set was available at the second annual project workshop in October 2004. This allowed an updated preliminary stock assessment to be undertaken with the model developed during the earlier ACIAR project.

Further data gaps and inconsistencies were identified during the workshop and processes developed to rectify these difficulties. Australian and PNG project counterparts worked with an external database consultant in April 2005 to further modify the logbook database, create new routines to monitor the accuracy and precision of logbook data entry and compare logbook, company landings and national exports. These data will be used to estimate the changes in fishing efficiency since 1974.

A second fishery independent survey of adult and immature prawns was conducted in March 2005. Before the survey, NFA staff had a community meeting in Kerema to explain the project and the purpose of the survey. A total of 110 trawls were made during the survey throughout the commercial fishing grounds and within the three nm closure. Of these 104 were from locations surveyed in 2004 and the rest were repeats of trawls near the three nm closure boundary. As in the previous year, populations of banana prawns were highest inside the three nm fishing closure and in the eastern part of the commercial fishing grounds. Significant catches of the valuable black tiger prawns were also made around Kerema and Freshwater Bays. The data from the two surveys will be combined to provide the basis of an assessment of the viability of a small-scale inshore fishery. This fishery will be within the three nm closure and be undertaken by local fishers.

**Project FIS/2005/022: Cross-institutional exchange: work placement at the Highlands Aquaculture Extension and Development Centre (HAQDEC), Aiyura, Eastern Highlands Province, PNG**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Leader</b>	Mr Brett Herbert Phone: 07 40350182 Fax: 07 40356703 Email: brett.herbert@dpi.qld.gov.au
<b>Collaborating Institutions</b>	
<b>Project Budget</b>	\$68,424
<b>Project Duration</b>	01/06/2004 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

**Project background and objectives**

In the Upper Fly region of Papua new Guinea, in contrast to the Eastern Highlands and other provinces where fish farming based on introduced carp, tilapia and trout species, has increased dramatically over the last few decades, the introduction of exotic fish species for farming has not been encouraged, for environmental reasons. The Ok Tedi Mining Ltd Livelihood Programs Department, National Fisheries Authority, and local pond owners have all indicated a desire to trial the culture of native species. This project builds on techniques and technologies developed by Queensland Department of Primary Industries and Fisheries in production of native freshwater fishes with an initial focus on breeding and fingerling production techniques for sooty grunter.

**Project progress**

**Year 1 (01/06/2004 to 31/12/2005)**

The first progress report is due in 2006.

## **Project FST/1998/113: Development of a sustainable, community-based essential oil industry in the Western Province of Papua New Guinea using the region's woody-plant species**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	CSIRO Forestry and Forest Products, Australia
<b>Project Leader</b>	Dr John Doran Phone: 02 6281 8319 Fax: 02 6281 8312 Email: john.doran@csiro.au
<b>Project Web Site</b>	<a href="http://www.ffp.csiro.au/">http://www.ffp.csiro.au/</a>
<b>Collaborating Institutions</b>	North Queensland Essential Oils Co-operative Association Ltd, Australia University of New South Wales, Australia University of Papua New Guinea, Papua New Guinea Papua New Guinea Forest Authority, Papua New Guinea James Cook University, Australia G R Davis Pty Ltd, Australia Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Budget</b>	\$675,417
<b>Project Duration</b>	01/01/2000 to 31/12/2005 (Project extended from 01/01/2003 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

In 1994 CSIRO's Australian Tree Seed Centre assisted villagers in Papua New Guinea's (PNG) Western Province to start production of essential oils from a local tree species. The oil used is similar in its chemistry and potential medical uses to eucalyptus or tea tree oil. It has a ready local market, and other villages have taken up production.

The fledgling oil extraction industry is poised to become a more valuable village-based enterprise. Such cash-generating activities are sorely needed in remote Western Province. Previous attempts to generate cash — such as rubber, rice, deer and crocodile farming — have foundered. Leaf oil production, however, is smaller in scale, community-based and, crucially, has been requested by the villagers themselves, who have heard of relatives in Irian Jaya carrying out similar activities. The project is facilitating the development of a sustainable, community-based, economically viable industry for extracting volatile plant oils in Western Province, PNG.

### **Project progress**

#### **Year 5 (01/01/2004-31/12/2004)**

A new oil still was commissioned in the village of Rouku, near Morehead in the Tonda Wildlife Management Area (TWMA). This brings the number of villages participating in oil production in PNGs Western Province to four (Rouku and Wando in TWMA and Kwiwang and Malam) and the total number of oil stills to six (Kwiwang and Malam have two each). Villagers at Rouku received advice on sustainable harvesting practice of the principal oil producing species, *Asteromyrtus symphyocarpa* known locally as Waria Waria, and advice on the operation and maintenance of the still. With the conclusion of the ACIAR project, it is expected that the Livelihood Programs Department of Ok Tedi Mining Ltd (OTML) will provide continuing support for maintenance of project infrastructure and development of village technical skills. This was discussed and agreed at a meeting of stakeholders in Port Moresby in December 2005.

The market situation for Waria Waria oil in 2003-04 in PNG was quite subdued creating a backlog in Daru of unpurchased oil. It was not until November 2004 that the bulk of the oil stocks were sold due to an increase in sales, particularly in Lae. OTML, in the December 2005 stakeholder meeting, undertook to improve the business skills of the villagers backed by the provision of microfinance. Such support will focus on the most motivated individuals, families and clans, where chances of commercial success in the long term are deemed to be greater than support communities at large. Formation of a cooperative of oil producers is also to be encouraged by OTML.

CSIRO Forestry and Forest Products in collaboration with the World Wide Fund for Nature (WWF) established new trials at Rouku Village to study sustainable harvesting techniques for *A. symphyocarpa*. This ecological study will deal chiefly with the effects of harvesting for oil production and villager use of fire on the long term sustainability of the *A. symphyocarpa* forest. On conclusion of ACIAR support for the project, WWF has undertaken to monitor, maintain and assess these trials in the long term. The results of this study will assist WWF staff in advising villagers on 'best practice' for harvesting *A. symphyocarpa*.

The project also sought to explore the occurrence and potential of other high value species that occur in the area, principally sandalwood. The sandalwood species endemic to PNG, *Santalum macgregorii*, has been heavily exploited in Central and Gulf Provinces, but little was known about its occurrence in Western Province. A survey, to map its occurrence, determine conservation issues, and to advise the villagers on *in situ* conservation measures was carried out along the coast of Western Province. The species was found to be quite localised in its occurrence in Western Province, preferring dry savannah habitat with sandy silt soils. There are only a few populations, of quite small size, that are under severe threat from frequent high intensity fires, a result of traditional burning practices. Herbarium voucher specimens and several heartwood samples for future chemical analysis were collected and processed. Flowering was observed but no mature fruit were available for collection.

## Project FST/1998/115: Domestication of Papua New Guinea's indigenous forest species

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	CSIRO Forestry and Forest Products, Australia
<b>Project Leader</b>	Mr Brian Gunn Phone: 02 6281 8258 Fax: 02 6281 8266 Email: brian.gunn@csiro.au
<b>Project Web Site</b>	<a href="http://www.ffp.csiro.au/">http://www.ffp.csiro.au/</a>
<b>Collaborating Institutions</b>	Papua New Guinea National Forest Service, Forest Management Division, Papua New Guinea
<b>Project Budget</b>	\$1,566,543
<b>Project Duration</b>	01/01/2000 to 30/06/2005 (Project extended from 01/07/2003 to 30/06/2005)
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### Project background and objectives

Papua New Guinea (PNG) is a land of great biodiversity, with more than 400,000 plant species. About 60 per cent of the country is forested, and most of this land is owned by thousands of clan-based groups. However, the growing human population, forest clearance for palm oil plantations, and the government's desire to earn revenue by exporting logs, are all threatening the native forest and its biological resources. Current logging practices are not sustainable; unless changed, there will be a gradual decline in economic and social amenity as the available area and diversity of the forest dwindle.

Despite the country's largely fertile soils, advantageous climate and its many suitable tree species, very little land (only about 60,000 ha) is devoted to plantation forestry of native trees. The country needs timber exports for foreign exchange earnings, and is now recognising that future development of the forestry industry will depend on expanding its plantations. Furthermore, the existing plantations are based on a limited number of indigenous species within the genera *Acacia*, *Araucaria* and *Eucalyptus*. There is, therefore, considerable scope for increasing the number of species used. Research is needed to identify suitable species, and help PNG better utilise its forest genetic resources.

The Australian Tree Seed Centre and CSIRO Forestry have considerable experience in seed collection, assessment and domestication of trees in the region. This expertise will be used in partnership with PNG's Forest Research Institute and National Forestry Service, to develop ways of domesticating and conserving some of PNG's valuable forest tree species.

### Project progress

#### Year 5 (01/01/2004-31/12/2004)

*Domestication of one PNG forest species:* The species *Endospermum medullosum* was chosen as the target species. Information was gathered by FRI staff on species distribution, areas to focus on for seed collections (5 sources) and information about fruiting in different locations in PNG. Information on seeding times is variable from year to year and from location to location. Attempts were made to gather information from field contacts regarding fruiting development. Three populations were sampled, planted and within a few weeks of sowing, an ample number of seedlings have been raised at the FRI nursery. Attempts are being made to acquire seed from other populations within PNG and explore opportunities for getting seed from Vanuatu.

*Germplasm conservation:* Plant material for sandalwood (*S. macgregorii*) was established as root sections and shoots grafted on to sandalwood rootstocks as part of a nursery propagation course. The result of the nursery propagation has been encouraging: eight out of a total of 20 grafted successfully. Approximately 22 wildlings/rooted sections from a total of 50 plants are still growing on in the nursery.

*Seed handling and propagation - Vegetative propagation:* Screening of PNG's 'lesser known tree species' to assess their ability to be propagated by cuttings continued. Potted hedge plants for nine species, including: *Elaeocarpus*, *Anisoptera thurifera*, *Trema Solomonensis*, *Castanopsis*

*accuminatisima*, *Vitex coffassus*, *Harpulia cupanioides* and *Gyrinops ledermannii* were undertaken. Some level of propagation success was achieved for most species.

*Human resource development:* A series of three workshops under the title *Leading Change. A Learning and Development Program for the PNG Forest Research Institute* was conducted for management staff at FRI, to develop strategic management frameworks in line with Forest Research Advisory Committee (FRAC) recommendations of March 2002. Each workshop was made up of 12 participants. By the end of the third workshop participants had achieved a satisfactory levels of understanding of the processes and outputs to apply them to the situation in FRI.

*Nursery training:* A two week training program was provided to staff at FRI. The first week comprising 12 participants focussed on basic nursery training with the second week dealing with vegetative propagation to which 5 FRI officers attended. Both courses were highly relevant and highlighted the need for further follow-up training. Many new techniques were discussed and put into training practice to include; improved composition of growing medium, sterilising medium, watering, hardening off and nursery hygiene.

*PNG tree species leaflets:* The conversion of the 27 tree species contained in the booklet *Seed Handling and Propagation of Papua New Guinea's Tree Species* under the project into leaflets is progressing. Minor revisions to the text are now complete. Staff are progressively working through building up the library of photos to compliment the tree descriptions. These photos include tree, bark, foliage, flowers. Project staff are also working on preparing drafts for an additional nine tree species leaflets.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Bureau of Rural Sciences, Australia
<b>Project Leader</b>	Dr Rod Keenan Phone: 02 6272 5582 Fax: 02 6272 3882 Email: rodney.keenan@brs.gov.au
<b>Project Web Site</b>	<a href="http://www.ffp.csiro.au/tigr/atscmain/">http://www.ffp.csiro.au/tigr/atscmain/</a>
<b>Collaborating Institutions</b>	Papua New Guinea Forest Research Institute, Papua New Guinea Southern Cross University, Australia Queensland Forest Research Institute, Australia Australian National University, Australia
<b>Project Budget</b>	\$640,143
<b>Project Duration</b>	01/07/2001 to 30/09/2005 (Project extended from 01/07/2003 to 30/09/2005)
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

Papua New Guinea (PNG) 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 per cent 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, customary owners, forest companies and small-scale users of forests. The project is working 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 will use technology, planning experience, and management techniques that have been developed for Australian native forests and adapt these to areas that are typical of PNG forests.

### **Project progress**

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

A major review of forest area assessment, inventory and planning systems used in PNG has been completed. This included remeasurement of 32 large permanent sample plots in cut-over native forests across PNG. Data from these plots has 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. Growth model analysis which suggests that the 35 year cutting cycle currently in place in PNG is probably too short to allow for commercially viable future harvests if all trees greater than 50 cm in diameter at breast height are cut. More economically and ecologically sustainable timber harvesting will be achieved through:

- 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.

An analysis was completed comparing timber volumes assessed in the 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 was also finalised.

A simple system to integrate existing forest area, inventory and growth information has been developed. This system produces more reliable estimates of future timber yield under different harvesting scenarios for incorporation into forest planning and project documents.

Significant capacity building has been achieved with staff in the PNG Forest Authority, Forest Research Institute and the Department of Environment and Conservation able to undertake improved analysis of forest inventory information and forest management options.

The project has achieved significant progress in building skills and knowledge of improved forest planning techniques, especially with training and development of forest inventory methods, review of the PSP database and training in Australia for PNGFA staff on a range of matters related to forest planning.

## **Project FST/2002/010: Domestication and commercialisation of multi-purpose indigenous trees and shrubs for food and other products in Papua New Guinea, the Solomon Islands and Queensland: a feasibility study with special reference to *Canarium* nut**

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	James Cook University, School of Tropical Biology, Australia
<b>Project Leader</b>	Professor Roger Leakey Phone: 07 4042 1573 Fax: 07 4042 1319 Email: roger.leakey@jcu.edu.au
<b>Collaborating Institutions</b>	National Agricultural Research Institute, Papua New Guinea Queensland Department of Primary Industries and Fisheries, Australia Macro Agribusiness Consultants Pty Ltd, Australia Michael Davis Consultants, Australia Commodities Export Marketing Authority, Solomon Islands
<b>Project Budget</b>	\$203,606
<b>Project Duration</b>	01/07/2004 to 30/09/2005 (Project extended from 01/07/2005 to 30/09/2005)
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

The indigenous tree nut *Canarium indicum*, known as Galip Nut in Papua New Guinea (PNG) and Ngali in the Solomons, is part of human dietary intake in both countries. As a result the species is domestically important for food security but less so as a potential cash crop. Some attempts have been made to develop, process and market the nut but these have not resulted in widespread cropping. Domestication of indigenous fruit and nuts is relatively common in many tropical countries. Such species are important to alleviating food insecurity and addressing nutritional deficiencies in dietary intake. They also provide an income opportunity that can help stimulate improvements in livelihoods. Such approaches towards domesticating indigenous species could also work in PNG and the Solomon Islands.

In PNG there are 22 species of *Canarium*, seven of which can be found in New Britain province. Little, however, is known about these species, with this project likely to increase knowledge. A feasibility study of agroforestry of Galip/Ngali is needed to determine if barriers to tree domestication exist in PNG and the Solomons and if these account for the lack of agroforestry utilising *Canarium* and other suitable tree species. This study will focus on existing participatory approaches that have been successful elsewhere in the tropics. The ability of agroforestry of Galip/Ngali to enhance food security and to create income generating opportunities will also be examined.

The project is determining the feasibility of developing a strategy and methodology for the parallel improvement of the food/nutritional security, and income generating opportunities of smallholder farmers through the domestication and commercialisation of indigenous fruit and nut species in PNG (East New Britain), SI and Australia.

### **Project progress**

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

The Feasibility Project identified that *Canarium* nuts are a high value, nutritious, premium product, with good processing attributes (drying, roasting, salting, etc.). Extracted kernels have a soft texture which is popular and allows a broad range of uses in confectionary/baking. The edible kernels are associated with healthy living in Melanesia. There are considerable opportunities for domestication, which would overcome the 'supply issues' that have caused the failure of earlier attempts to commercialise the kernels. These opportunities are enhanced by large tree-to-tree variability in key kernel traits available for cultivar selection. The likely success of domestication and commercialisation is enhanced by building on traditional use, existing markets and recognised livelihood benefits.

Attitudes and perceptions of communities and consumers towards indigenous fruits and nuts in the household food intake and in landuse were:

- all rural households use Galip for food, 80 per cent as a source of cash and 50 per cent for bartering. Cash is mostly used to buy food. Galip is the preferred species (55-75 per cent) of nut for food and for income generation,
- sixty per cent of nationals and expats eat fresh raw Galip kernels, another 20-25 per cent eat dried kernels. Processed (roasted) kernels are not readily available, but about 10 per cent mentioned consuming them. Galip was preferred above all other species of indigenous and exotic nuts. Most (70-90 per cent) respondents recognised Galip as a healthy product, 60 per cent of respondents would like to be able to buy more Galip. Urban markets are willing to pay higher prices, and
- fifty to seventy per cent of farmers would like to grow more Galip, mostly (55-65 per cent) for their income generating potential, especially in areas close to markets. In remote areas, food was the main reason given for growing more. 80-90 per cent of farmers recognised potential to improve kernel size and taste through domestication.

Potential opportunities and constraints for domestication and commercialisation are:

- market confidence (both regional and export) satisfying local demand first,
- semi-processing shows great promise, with cracking of nuts in villages (to provide employment to women) and drying and packaging of kernels done centrally. Processing must include; traceability to origin, and preparation to food safety certification standards and good manufacturing practices,
- training is needed at the village level on post harvest techniques to ensure product safety for certification and quality,
- Significant job creation and rural income streams are achievable with proper industry development, based on nucleus estates in key provinces to provide a 'Commercial Hub'.
- Consumer acceptability was assessed by sensory analysis. Roasted kernels were scored highest. Average score was 57 per cent, which was lower than four commercial nut species (macadamia, cashew, pecan and peanuts), which scored 76-85 per cent. Fresh kernels were not tested. The drying process seemed to have detrimental effects on flavour.

The principle selection criteria for domestication were identified as: kernel mass, kernel/nut ratio, taste, ease of cracking and seasonality of production. Analysis of kernels from 18 Galip trees revealed tree-to-tree variation of 67-75 per cent in fat/oil content, 11.2-13.6 per cent in protein, 5.7-11.4 per cent in carbohydrate, 15.3-197mg/kg in sodium and energy content of 2896-3086kJ/100g. Kernel drying has to occur within 24 hours of cracking the nuts if quality is to be retained. Dried kernels can be stored in polythene containers for a few months, and in glass containers for a few years. Vacuum packing causes oil leakage. Opportunities for year-round production in Melanesia suggest that the development of a 'Melanesian Supply Chain' offers the most potential for longer term industry development, with maximum benefits for village communities.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	Australian National University, School of Resources, Environment and Society, Australia
<b>Project Leader</b>	Dr Ryde James Phone: 02 6125 4330 Fax: 02 6125 0746 Email: ryde.james@anu.edu.au
<b>Collaborating Institutions</b>	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
<b>Project Budget</b>	\$149,989
<b>Project Duration</b>	01/04/2005 to 30/09/2006
<b>ACIAR Research Program Manager</b>	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 7,000 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**

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

The first progress report is due in 2006.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	CSIRO Forestry and Forest Products, Australia
<b>Project Leader</b>	Mr Brian Gunn Phone: 02 6281 8258 Fax: 02 6281 8266 Email: brian.gunn@csiro.au
<b>Collaborating Institutions</b>	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
<b>Project Budget</b>	\$627,169
<b>Project Duration</b>	01/04/2005 to 31/03/2008
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

Harvesting of native, primary forests has been an important export industry for Papua New Guinea (PNG) NG. 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. Continuing 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. A climate favourable for several in-demand species, good soils and knowledge of forestry and agroforestry 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 1 (01/04/2005 to 31/03/2006)**

The first progress report is due in 2006.

## **Project FST/2005/049: Mastotermes scoping study in PNG**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Department of Primary Industry, Fisheries and Mines, Australia
<b>Project Leader</b>	Dr Brian Thistleton Phone: (08) 8999 2257 Fax: (08) 8999 2312 Email: brian.thistleton@nt.gov.au
<b>Collaborating Institutions</b>	
<b>Project Budget</b>	\$70,000
<b>Project Duration</b>	01/08/2005 to 31/01/2006
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

The giant termite *Mastotermes darwiniensis* was inadvertently introduced to Lae during or shortly after World War II. Originally confined to the hospital and surrounding areas, in recent years the pest has recently rapidly extended its range to adjoining residential areas, government buildings and other infrastructure. The termite has the potential to develop into a major pest of the built-in environment, infrastructure, native flora, horticulture and agriculture right across at least the lowlands of Papua New Guinea. The aim of this contract then is to define the extent of the existing and potential problem, and to recommend responses. The specific objectives are to:

- Define much more precisely the current extent and nature of the incursion,
- Develop a prognosis of likely rate of spread and of the potential impacts, if no management strategies are adopted, and
- Propose practical longer term management options.

### **Project progress**

**Year 1 (01/08/2005 to 31/01/2006)**

The first progress report is due in 2006.

## **Project FST/2005/050: PNG agroforestry systems - scoping study**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Australian National University, School of Resources, Environment and Society, Australia
<b>Project Leader</b>	Professor Peter Kanowski Phone: 02 6125 2667 Fax: 02 6125 0746 Email: peter.kanowski@anu.edu.au
<b>Collaborating Institutions</b>	
<b>Project Budget</b>	\$149,442
<b>Project Duration</b>	01/05/2005 to 28/02/2006
<b>ACIAR Research Program Manager</b>	Dr Russell Haines

### **Project background and objectives**

Native forests in PNG have generally been overexploited and will soon be commercially exhausted. Prospects for industrial-scale plantations are severely limited by land ownership issues. Such systems may offer the best prospects for landowners to benefit from tree growing and for sustainable forest industries based on local value-adding. This project aims to build on Papua New Guineans wealth of documented local knowledge on agroforestry and innovative and adaptive farming systems. It will also investigate opportunities for further enhancing PNG agroforestry systems through greater incorporation of high-value tree growing. This will be achieved through a detailed review of relevant PNG farming systems, policy and literature; consultation with relevant stakeholders and officials; and synthesis of current knowledge and stakeholder judgement.

### **Project progress**

**Year 1 (01/05/2005 to 30/04/2006)**

The first progress report is due in 2006.

## Project LPS/2001/077: Poultry feeding systems in PNG

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	South Australian Research and Development Institute, Pig and Poultry Production Institute, Australia
<b>Project Leader</b>	Dr Phil Glatz Phone: 08 8303 7786 Fax: 08 8303 7689 Email: glatz.phil@saugov.sa.gov.au
<b>Collaborating Institutions</b>	National Agricultural Research Institute, Papua New Guinea Morobe Provincial Division of Agriculture and Livestock, Papua New Guinea Madang Provincial Department of Primary Industries, Papua New Guinea Salvation Army Development Program, Papua New Guinea Lae Feed Mills, Papua New Guinea
<b>Project Budget</b>	\$449,975
<b>Project Duration</b>	01/07/2002 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr Bill Winter

### Project background and objectives

The Papua New Guinea (PNG) smallholder broiler production system involves about 50,000 families and produces six million birds a year, with a value of AUD 54 million. Smallholders purchase day-old chicks, grow them out for six to eight weeks using commercial feeds and some locally available feeds, and sell them as live birds in local markets. At present, most farmers use imported concentrated feeds that cost AUD 4–5 per bird.

Cheaper inputs would help smallholders to be more profitable and efficient. In particular, the use of locally available feeds could reduce costs by up to A\$1.50 per bird. However, locally available feeds must first be systematically evaluated and rations formulated using those feeds. This requires a more extensive testing facility than is currently available in PNG and better information about productivity using different local feeds. The profitability of smallholder broiler chicken production in PNG will be improved by identifying cheaper local food sources and reducing reliance on imported feed.

### Project progress

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

*Establish a quality-assured research facility in PNG:* Similar facilities as those at the Pig and Poultry Production Institute (PPPI) at Roseworthy in South Australia were considered appropriate for use in PNG at the National Agricultural Research Institute (NARI) in Lae. Cages and other equipment for the PNG unit were made in Adelaide and were placed in a container and shipped to Lae. A junior scientist from NARI visited PPPI and undertook training in the feed evaluation unit, including working in a feed trial, milling feed and faecal samples, and measuring energy values of samples and recording data. The first trials at Lae commenced in April 2003 with assistance from a PPPI technical officer. Lae Feed mills provided feed ingredients for the test diets. Growth and feed conversion of birds in the PNG was excellent and matched the growth of birds in the PPPI feed evaluation unit. A shipping container for feed storage was sited next to the AME building. A roof, dehumidifier and air conditioner were fitted to the container and it was also made vermin proof.

*Formulate and evaluate low-cost milled and home mix rations:* An inventory of feed resources for sampling in PNG was tabulated; listing maize, sorghum, sweet potato, cassava, banana and legume leaves from village crops. In addition wheat millrun, rice bran, palm kernel meal, copra meal, tuna offal meal, wheat and pyrethrum marc is available from various location in PNG. Routine testing of metabolisable energy of these feed resources and analysis of feed and excreta samples were conducted. The feeds tested were copra meal, palm kernel cake, wheat mill run, sweet potato, sweet potato leaves, sago, cassava, rice bran, wheat, coconut, Wewak, RDT and IFC fish meal, gliricidia leaves, Lae Feed Mills broiler starter, Lae Feed Mills broiler finisher and rice hulls (90 per cent broiler finisher with 10 per cent rice hulls included and 85 per cent broiler finisher with 15 per cent rice hulls

included). Birds fed diets with cassava, sweet potato and palm kernel meal performed to a good standard.

The AME program comprised five runs testing up to four diets in each trial. Data from four of the AME runs has been processed. Palm kernel expeller meal and copra meal were chosen for study on the basis of high fibre content and availability in PNG. Birds fed diets based on copra meal had higher gains and better feed conversions than those on the palm kernel meal. Two broiler grow-out trials were conducted to evaluate rations which might be suitable for village meat chickens. Diets containing maize, cassava, copra meal, fish meal and leucaena leaf meal were compared to a commercial ration. In the first trial feed conversion was superior in the commercial ration but in the second trial there was no difference in feed conversion between the commercial or home mixed diet. Subsequently it was resolved that to increase use of local feeds in broiler rations that Lae Feed Mills develop a concentrate ration comprising mainly fish meal and copra meal which could be fed with sweet potato.

*Establish a system for information exchange:* A draft survey form was prepared seeking information from PNG smallholder farmers on chicken feeding practices. The survey questions also aimed to obtain information on farmer's attitudes, constraints and needs in raising meat chickens. The first group of 70 broiler chicken farmers were surveyed in the Bululo District of the Morobe Province, revealing feed and travelling costs are a burden and demand for live birds is high, with community agreement over prices. The income from sale of birds is used to meet family needs. Follow up surveys were conducted with 60 farmers in Finschhafen and Madang. The Madang survey (100 farmers from 5 districts) was completed in August 2003 and the Eastern Highland survey in October 2003. Farmers have similar problems to those encountered in Morobe.

## **Project PHT/2001/016: Microbial contaminants associated with sago processing and storage in Papua New Guinea**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	James Cook University, School of Biomedical Sciences, Australia
<b>Project Leader</b>	Associate Professor Warren Shipton Phone: 07 47814123 Fax: 07 47791526 Email: Warren.Shipton@jcu.edu.au
<b>Collaborating Institutions</b>	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
<b>Project Budget</b>	\$399,858
<b>Project Duration</b>	01/07/2002 to 31/12/2005 (Project extended from 01/01/2005 to 31/12/2005)
<b>ACIAR Research Program Manager</b>	Dr Greg Johnson

### **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 utilized. 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 AUD 150-200 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 which may cause sago haemolytic disease. This 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 3 (01/07/2004-30/06/2005)**

Sociological surveys of sago producing areas were continued to assess the impact of collection and storage techniques on the fermentation events occurring in the sago starch. A composite flow chart of sago production has been created. Analysis of the flow chart, in conjunction with the sociological data, has enabled the identification of several critical control points at which microbial contamination can be minimised. These have been established at trunk storage, pith removal, starch extraction and storage and food preparation. All these points represent 'category 2 controls', 'meaning that food borne illnesses can be minimised but not eliminated by attending to various guidelines.

The greatest single factor contributing to sago starch contamination during harvesting and extraction was the quality of the wash water used. Suggested improvements in the location of some the extraction areas and restricting access of animals to the sites should lead to a decrease in certain types of contamination. In the absence of clean water, storage of sago under vigorous fermenting conditions for several days to one week can minimise some hazardous populations of food borne bacteria. These preliminary observations follow from laboratory experiments which show that specific

food-poisoning bacteria decline rapidly in numbers in the first week of storage. The superiority of fermentation in sago-leaf bound bundles and in clay pots is emphasised over other methods, such as in open baskets.

Identifications of fungal, yeast and bacterial isolates were completed on samples from the Western Province and the identification of isolates from food associated with a fatal case of sago haemolytic disease was commenced. Identification focussed on fungal and bacterial isolates capable of haemolytic activity on the one hand and food poisoning bacteria on the other. Significant bacteria and filamentous fungi were identified and enumerated. A number of strongly haemolytic organisms were isolated and present in considerable numbers in some samples. Fungal population levels, particularly as measured by ergosterol content, increased with storage time. Population levels shown by this group of microbes was more pronounced when sago was stored in leaves and woven baskets. Classical bacteria of public health significance were also identified. *Escherichia coli* showed the greatest survival ability of any organism investigated. Survival curves for a number of bacteria were established in both freshly harvested and older sago. Numbers of most organisms were reduced to low levels by 10 days, except for *E. coli*. Strain characteristics of this organism are yet to be investigated to determine the incidence of enterohaemorrhagic isolates.

Sago samples were analysed for well known mycotoxins capable of causing human disease. These samples were of varying ages and organoleptic states. Cyclopiazonic acid was detected in two sago samples and ochratoxin was produced after prolonged refrigeration. However, considering the number of samples analysed (58), contamination of sago by the common mycotoxins (aflatoxins, zeralenone) was considered of little overall practical significance. The causal agent of sago haemolytic disease is probably a microbe producing a novel haemolysin. One promising haemolysin has strong lipid affinity and has the ability to lyse (destroy through antibodies) human red blood cells rapidly. Some of the isolates of *Penicillium* and *Aspergillus* showing strong haemolytic activity were also capable of citrinin production.

Conditions favouring fermentation are associated generally with the storage of sago, for the moist sago is commonly stored in bulk in containers (leaves, plastic or clay pots) thereby ensuring anaerobic conditions. The identification of a number of different bacterial activity groups is being actively pursued in order to give a clearer idea of the microbes essential to rapid fermentation. The main microbial metabolites are in the process of being identified. The groups of significance, so far identified, go beyond the lactobacilli. The fermentation process appears to function to encourage a decline in certain food borne bacteria of public health significance.

To publicise project findings, a Symposium on *Microbial contaminants associated with sago processing and storage in Papua New Guinea and their association with life threatening Sago Haemolytic Disease* was held in Port Moresby during September with Government officials and medical practitioners invited.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	University of Sydney, Faculty of Agriculture, Food and Natural Resources, Australia
<b>Project Leader</b>	Professor David Guest Phone: 02 9351 2946 Fax: 02 9351 4172 Email: <a href="mailto:guestd@agric.usyd.edu.au">guestd@agric.usyd.edu.au</a>
<b>Collaborating Institutions</b>	Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea MasterFoods Australia New Zealand, Australia Papua New Guinea University of Technology, Papua New Guinea
<b>Project Budget</b>	\$549,919
<b>Project Duration</b>	01/01/2005 to 31/12/2007
<b>ACIAR Research Program Manager</b>	Dr Greg Johnson

**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 (AUD 87 million) a year based on 42,000 tons 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, not smallholders, were the dominant producers. 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 an 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 development of effective and affordable strategies, in partnership with farmers, is underway to develop effective management options of the major disease threats to production, by:

**Project progress**

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

The first progress report is due in 2006.

## **Project SFS/2001/036: Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks**

<b>Overseas Collaborating Countries</b>	Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu
<b>Commissioned Organisation</b>	La Trobe University, School of Economics, Australia
<b>Project Leader</b>	Dr John Kennedy Phone: 03 94792313 Fax: 03 94791654 Email: j.kennedy@latrobe.edu.au
<b>Project Web Site</b>	<a href="http://www.business.latrobe.edu.au/staffhp/jkennedy/ACIARTechPapers.htm">http://www.business.latrobe.edu.au/staffhp/jkennedy/ACIARTechPapers.htm</a>
<b>Collaborating Institutions</b>	University of Queensland, Australia Secretariat of the Pacific Community, New Caledonia Forum Fisheries Agency, Solomon Islands
<b>Project Budget</b>	\$577,585
<b>Project Duration</b>	01/01/2002 to 31/12/2005
<b>ACIAR Research Program Manager</b>	Dr Simon Hearn

### **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 and the Secretariat of the Pacific Community 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 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 3 (01/01/2004-31/12/2004)**

Distant water fishing nations such as Japan, USA, South Korea, Taiwan and China are interested in paying for access to stocks in the Exclusive Economic Zones of Pacific Island countries. The special problems of obtaining international agreement on efficient management of migratory fish have been recognized in the United Nations Fish Stocks Agreement, which came into force in 2001. This has led to the setting up of commissions to oversee the conservation and management of migratory stocks in various parts of the world's oceans. The commission for the region which is the focus of the project (Commission For the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific) was installed in December 2004. The formation of the Commission is likely to focus attention on the benefits of coordinated action by the Pacific Island countries to improve efficiency in managing stocks.

*Translating the computer code of the disaggregated bioeconomic tuna model from C++ to Visual Basic:* This translation was undertaken so as to modify the model to experiment with different model assumptions, such as modelling year to year changes in stocks over a 15-year period under alternative effort levels of harvesting fleets; and to be able to experiment with a faster optimising routine.

*Progress with the small highly aggregated bioeconomic model:* A basic version of the model was completed, incorporating an optimising routine. This is being developed to model decisions of distant water fishing nations on catch effort within the EEZ's of the Pacific Island countries in response to access charges set by these countries. To ensure feasible computing times to obtain solutions, a small highly aggregated model is required, with parameters which can be calibrated from test results from the larger model.

*Investigating data and methods for determining the cost of increasing fleet capacity over time as original capacity declines:* Data were collected and analysed on the distribution of ages, capacities and prices of Purse Seiner and Longline vessels from published reports and internet sites advertising asking prices for second-hand vessels. The results were documented in a working paper.

*Colour mapping on Microsoft Excel spreadsheets of the aggregation of variables such as fishing effort and catch across the 5 degree squares of the Western and Central Pacific Ocean, with calculation of subtotals inside and outside the combined EEZ's of the Pacific Island countries:* A spreadsheet program was written for display of the fishing effort data by fleet entered for the large disaggregated model in each five degree squares of the WCPO, differentiating squares by colour according to whether they were land, sea within the Pacific Island countries' EEZs, and sea outside the Pacific Island countries' EEZs. This is important for understanding the overall magnitude and distribution of the effort of different fleets in different runs of the model, and for displaying data on catch and effort across recent years from the Oceanic Fisheries Program database. The percentage of total catch outside and inside the Pacific Island countries' EEZs can be calculated.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Tonga, Vanuatu
<b>Commissioned Organisation</b>	University of Queensland, The School of Land and Food Sciences, Australia
<b>Project Leader</b>	Dr Jane O'Sullivan Phone: 07 33654811 Fax: 07 33651188 Email: j.osullivan@mailbox.uq.edu.au
<b>Collaborating Institutions</b>	Ministry of Agriculture and Forestry, Tonga Department of Agriculture Livestock and Horticulture, Vanuatu National Agricultural Research Institute, Papua New Guinea
<b>Project Budget</b>	\$1,067,375
<b>Project Duration</b>	01/07/1999 to 31/07/2005 (Project extended from 01/01/2005 to 31/07/2005)
<b>ACIAR Research Program Manager</b>	Dr Christian Roth

### **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 is providing information to help in the diagnosis of nutritional disorders affecting yam plants, prior to developing feasible options for improving crop nutrition in affected areas.

### **Project progress**

#### **Year 5 (01/07/2005 to 30/06/2005)**

In Papua New Guinea (PNG), *Gliricidia* live-staking plots have been planted with yam for the third year in Dugumor, Madang Province, for a second year at Bubia Research Station and for the first season at Mutzing in the Markham Valley and in three villages on Kiriwina Island in the Trobriand group, Milne Bay Province. In addition, fertilizer rate trials were planted at Dugumor and on Kiriwina. At Tanam in the Markham Valley, an experiment is investigating zinc deficiency and possible remedies with both yam and maize. Mid season observations show that zinc deficiency was exacerbated by NPK fertilization, and ameliorated by either zinc application (soil-applied or foliar sprays) or chicken manure. Harvests are underway at the time of reporting.

In Vanuatu, the phosphorus rate trial at Malo was harvested in August, and replanted for a second year, this time with potassium applied to two replicates. A small P response was measured, but K response was not evident. At Tagabe Research Station, parallel experiments compared the response of *Dioscorea alata*, *D. rotundata* and sweetpotato to N, P and K applications, but no responses were evident. At VARTC, the growth and development of *D. esculenta* was studied, with particular attention to root morphology. Destructive harvests each month involved careful excavation of the roots and recording of root length and depth. Roots were observed to remain very shallow (less than 10 cm) while extending out from the plant for over two metres, but ultimately growing down to about 30 cm depth. Feeder roots were not concentrated in or under the mound, except for those growing from

developing tubers. These results call to question the efficacy of fertiliser placement in the mound, and the adequacy of one metre guard rows between fertiliser treatments.

In Tonga, the project established five sites comparing *D. alata* response to N and P rates on soils planted four to five months with *Mucuna cochinchinensis* (velvet bean) and *Panicum maximum* fallow. The results did not show any significant responses as last year. The project staff in Tonga reported that severe drought during tuberisation was the likely cause of no significant responses. *Mucuna* roots were examined microscopically and found to be heavily populated with vesicular-arbuscular mycorrhizae (VAM). In the greenhouse, yams were successfully grown in pot experiments demonstrating P responses on two soils, both taken from sites continuously cropped for five years prior to sampling.

At the University of Queensland, solution culture experiments were completed for deficiencies of nitrogen, boron, iron, copper and molybdenum. In addition, toxicities of boron, zinc and copper were developed to greater intensity than achieved in the trial last year. The copper deficiency experiment successfully used Amberlite IRC-718 cation-chelating resin to induce a range of deficiency levels, with well-developed symptoms. Borate-binding anion-exchange resin Amberlite IRA-743 was trialled for the second time, again with poor results suggesting phytotoxicity to yam. More than 1000 leaf samples were generated by the solution culture experiments, and some 350 samples received from overseas programs. These have been processed in the laboratory, but analysis results are not yet collated for reporting. Due to the sale of the University's research farm at Redland Bay, the root crops germplasm collection was moved to the DPI Redlands Research Farm at Cleveland. All but one of the yam genotypes received from IITA have been destroyed on account of virus infestation. From the remaining four *D. alata* genotypes, leaves were sampled monthly to track changes in leaf nutrient concentrations in leaves at various positions on the vine.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	CSIRO Land and Water, Davis Laboratory, Australia
<b>Project Leader</b>	Ms Suzanne Berthelsen Phone: (07) 4753-8534 Fax: (07) 4753-8600 Email: Suzanne.Berthelsen@csiro.au
<b>Collaborating Institutions</b>	Oil Palm Research Association, Papua New Guinea James Cook University, Australia
<b>Project Budget</b>	\$917,638
<b>Project Duration</b>	01/07/2002 to 30/09/2007 (Project extended from 01/07/2007 to 30/09/2007)
<b>ACIAR Research Program Manager</b>	Dr Christian Roth

### **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 and nitrogen.

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 project is working 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, this work 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 3 (01/07/2004-30/06/2005)**

While leaf symptoms typical of magnesium deficiency had been evident in West New Britain province for many years, field trials with soluble magnesium fertilisers had not shown responses, so it was not known whether or not magnesium deficiency was affecting yield. The project established several field trials, one of which was designed to answer this question. During the last 12 months, the palms have started producing fruit and the yield data have shown for the first time that magnesium deficiency is indeed limiting yield in this environment.

During this period, our understanding of the physiology of the deficiency has advanced through measurements of magnesium transport within palms in the field, and from solution culture studies. As fronds are produced and the canopy moves upwards, magnesium is extracted from the oldest fronds and transported to the youngest frond. The process is most pronounced in palms showing magnesium deficiency symptoms and differs between progeny. Within the frond, chlorophyll content increases rapidly with increasing leaf magnesium content, up to an optimum around 0.1-0.3 per cent.

The project started with the hypothesis that poor magnesium uptake was related to high calcium status of the soils. It was discovered that the high calcium and low magnesium status of the soils is closely related to soil mineralogy, which is related in turn to the particular volcanic origin of the ash upon which the soils have formed. Soils around the Witori caldera have low magnesium whereas those near the Dakataua and Ulawun volcanoes have higher magnesium. All the soils have low ability to retain magnesium relative to calcium. Their ability to retain potassium relative to calcium varies, and is again related to their particular volcanic origin.

The field trials assessing fertiliser management options will start producing yield results next year. However, results from other work this year have suggested several other management approaches. Firstly, by sampling existing trials we have found that magnesium retention is much higher in soil upon which pruned fronds or empty fruit bunches have been placed. Secondly, from the physiology work it appears that magnesium retention within the palm might be enhanced by delaying pruning. In order to predict the best ways to maximise uptake of magnesium and potassium by palms, we are building water/solute transport models to test various approaches. Those models require accurate spatial distribution of root uptake, which we measured for two sites using water extraction this year.

Scientific and social impacts of the project accrued through the experimental results and through training activities. Three Papua New Guinean scientists and over 80 extension and field staff benefited from workshops and training in soil science, plant nutrition and related subjects.

**Project SMCN/2005/043: Analysis of biophysical and socio-economic constraints to soil fertility management in the PNG Highlands**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	University of Queensland, School of Land and Food Sciences, Australia
<b>Project Leader</b>	Dr Gunnar Kirchhof Phone: 07-33651364 Fax: 07-33651177 Email: g.kirchhof1@uq.edu.au
<b>Collaborating Institutions</b>	Australian National University, Australia Queensland Department of Primary Industries and Fisheries, Australia National Agricultural Research Institute, Papua New Guinea
<b>Project Budget</b>	\$149,662
<b>Project Duration</b>	01/08/2005 to 30/06/2006
<b>ACIAR Research Program Manager</b>	Dr Christian Roth

**Project background and objectives**

In Papua New Guinea's highlands soils are rich and productive. Both crop production and agroforestry are widely practiced. The most extensively grown crop is sweet potato, the main food staple, cultivated on between 50 and 90 per cent of arable land. Recent declines in sweet potato yield suggest soil fertility is also declining. Pests and diseases may play a role, as may the shortening of fallow periods to cater for increased cropping to feed a growing population. Understanding the factors contributing to soil fertility and sweet potato yield decline is needed to guide future R&D activities. Information to build this understanding will be collected in determining these factors, including the socio-economics of farmer decision-making.

**Project progress**

**Year 1 (01/08/2005 to 30/06/2006)**

The first progress report is due in 2006.

## Project CP/2000/044: Taro beetle management in PNG and Fiji

<b>Overseas Collaborating Countries</b>	Fiji, Papua New Guinea
<b>Commissioned Organisation</b>	Secretariat of the Pacific Community, Fiji
<b>Project Leader</b>	Mr Sada Lal Phone: 679 3379225 or 679 3370733 ext. 225 Fax: 679 3386326/337 0021 Email: SadaNL@spc.int
<b>Collaborating Institutions</b>	CSIRO Entomology, Australia Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, Papua New Guinea
<b>Project Budget</b>	\$711,309
<b>Project Duration</b>	01/01/2002 to 31/12/2005
<b>ACIAR Research Program Manager</b>	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 production 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 fungi such as *Metarhizium* is attractive because fungi are specific, natural 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 to improve the 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: the fungus *Metarhizium anisopliae* (Ma), and the virus *Baculovirus oryctes* (OrV).

### Project progress

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

The SPC Pest Management in the Pacific (PMP) programme (PMP) is one of the two major projects of SPC-Plant Protection Service. PMP is funded jointly by Australia (AusAID and ACIAR) and New Zealand (NZAID). The other project is Plant Protection in the Pacific (PPP), funded by European Union (EU). Activities in this project have links to both SPC initiatives.

#### Papua New Guinea:

*Metarhizium Anisopliae* Ma Field Trial 2 (Keravat) – this was a repeat of trial one (reported in 2003) using the same design. Three dosages of Ma were tested against the standard rate of Chlorpyrifos and an untreated control. Ma and Chlorpyrifos failed to give any significant control of the beetle. This further indicates Ma's limitations as a single application.

#### Ma/Breeding Sites (and Continuous Application in Successive Taro Cultivations):

Ma in single application is not effective, therefore, placing it in an artificial breeding site in taro plantations may reduce the beetle population over a period of time.

Two strains of *Ma* FI-1452 (the standard) and FI-1472 (collected from the Highlands) were tested to check on the rate of decline of *Ma* conidia in the top soil at Keravat over a one year period. So far FI-1472 seems to deteriorate faster. Two strains of *Ma* (FI-1452 Standard TB 101) and FI-1472 (Highland strain) were tested on two beetle species *P. Woodlarkiana* and *P. huebneri*. The results showed that both *Ma* strains killed both sexes of both species of Taro Beetle. FI-1452 was better on *P. huebneri* at a lower rate but not on *P. woodlarkiana*.

*On Farm Adaptive Work:* Three target groups have been identified for On Farm Work to determine this. They are: Back Yard Gardens, Smallholder Farms and Institutions.

*Ma Mass production:* a) The developed protocol has been followed with successful *Ma* cultures now produced without difficulty. Some success has been achieved with chemical sterilisation and the technique should soon be mastered. Both strains of *Ma* are maintained in culture at Keravat and Bubia and re-cultured on a monthly basis to retain their virulence

*Baculovirus Oryctes:* This experiment to determine the pathogenicity of the virus was conducted but DNA in the beetle specimens could not be detected due to an improper preservation method. A simplified form of the original experiment will be conducted early next year to first establish that virus transmission and lethal infection of Taro beetles is possible.

*Insecticides:* Bifenthrin Insecticide is being trialled to test dosage rates. The trial will be finally harvested in March 2005. *Ma*, Confidor and Bifenthrin continue to be progressively trialled, through planting and harvesting at one, three, five and seven months.

#### **Fiji:**

*Comparison of two rates of Ma with chemical Suscon Indigo:* The trial was harvested in March. Beetle infestation was low making detection of the effect of the treatments difficult. There was no significant difference in reduction of the beetle population by either of the treatments. An evaluation of possible synergistic interactions between different dosage of Confidor insecticide and *Ma* had similar problems with low beetle infestation.

## **Project FIS/1999/025: Optimal release strategies for restocking and stock enhancement of the tropical sea cucumber, sandfish (*Holothuria scabra*)**

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	WorldFish Center, New Caledonia
<b>Project Leader</b>	Dr Warwick Nash Phone: 687 262000 Fax: 687 263818 Email: w.nash@cgiar.org
<b>Collaborating Institutions</b>	Australian Institute of Marine Science, Australia Ministry of Agriculture and Fisheries, Solomon Islands
<b>Project Budget</b>	\$1,171,638
<b>Project Duration</b>	01/04/2000 to 30/06/2006 (Project extended from 01/04/2004 to 30/06/2006)
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

Sea cucumbers, processed into 'beche-de-mer', are a valuable source of income for many coastal communities in the Pacific Islands and the developing nations of South and Southeast Asia. The sea cucumbers are easy to harvest, process and store. Wholesale prices for first grade beche-de-mer of around US\$50 per kg have resulted in severe over-fishing in many tropical developing countries. It is now apparent that depleted stocks of sea cucumbers can take decades to recover. The release of juvenile sea cucumbers produced in hatcheries is seen as the most expeditious way to rebuild stocks. Eventually, the release of cultured juvenile sea cucumbers also has the potential to increase production beyond historical levels.

ACIAR has funded research at the WorldFish Center in the Solomon Islands to progressively develop, assess and transfer the technology for propagating and releasing tropical sea cucumbers. During the first stage of the project it was established that sandfish (*Holothuria scabra*) is the species most suited to restocking. They can be reared *en masse* in hatcheries on micro-algal diets, and juveniles can be grown in simple, land-based nursery systems with minimal input of food. This project is the second stage of the partnership, which aims to identify the strategies for optimising survival of released juveniles, by developing cost-effective methods to ensure that a large proportion of cultured, juvenile sandfish released into the wild survive to adulthood.

### **Project progress**

#### **Year 4 (01/04/2004-31/03/2005)**

Juvenile sandfish (*Holothuria scabra*) were produced at the hatchery at Saint-Vincent for the third consecutive spawning season. Almost 20,000 juveniles were cultured and grown to sizes greater than 1 g in the first quarter of 2005. Several experiments were conducted in earthen ponds to develop methods for scaling up production of large-sized juveniles. Of note, we have identified ways to significantly improve growth of juveniles in 'hapa' enclosures. Fake sea grass units provide more surface area on which juveniles feed. Shading hapas was not beneficial. A non-linear relationship between initial juvenile size and their survival in hapas was found – this will benefit future aquaculture of sandfish by showing the best size at which to transfer juveniles from the hatchery into hapas in ponds. Experiments on different feeds and sediment addition in 'bag net' enclosures showed that feed is only needed when ponds have low natural productivity, and shrimp starter feed is best for the growth of sandfish from one gram onwards.

Nine thousand sandfish juveniles were grown to one to ten grams and released in the large-scale experiment. Four sites were selected and three open sea pens of 500 m<sup>2</sup> were set up at each site. The juveniles were tagged with one of two fluorochromes, then released into the pens at densities of 0.5, 1, or 3 per square metre. Censuses after two months indicate complete mortality at one site and high mortality at the other three sites, although it is possible that the low water temperatures at that time made the recaptures more difficult because animals burrowed deeper than normal, making them difficult to find. Further censuses will be carried out, as planned, to assess the survival rates over a longer period. The large-scale trial release of 4,000 sandfish juveniles, which started in July 2004, has shown much higher survival. At one site, survival has been very high and the sandfish have already

reached the size of first maturity, one year after release. The monitoring of that trial has been ongoing for one year and will continue for another six months.

The long-term tagging experiment, initiated in January 2004 was completed in January 2005. The results are a breakthrough in the development of reliable, inexpensive markers for juvenile sandfish. Two fluorochromes, calcein and tetracycline, showed complete retention in juveniles over the 12 month duration. Detecting the mark is a short, straightforward process that will be easy for fishery workers in the Pacific. The first manuscript to disseminate the findings is in internal review. Additional experiments were conducted and show the optimal protocols for administering these chemical tags.

The stock assessment surveys of sandfish were completed in the Northern and Southern Province, and stock assessments of other species were completed in the Loyalty Islands Province. Surveys of 35 sites on La Grande Terre, through 314 manta-tow transects, revealed only seven sites had good sandfish stocks. WorldFish has since helped the Northern Province to develop management regulations for their sea cucumber fishery. In the Loyalty Islands Province, were surveyed 34 sites through 305 transects. Significant stocks of black teatfish (*Holothuria whitmaei*), exist at 10 sites, and were at higher density in Lifou and Maré than Ouvéa.

Requests for information on sea cucumber culture and restocking have been steadily increasing. Project-related research presentations were given at the Aquaculture Australasia 2004 conference (Sydney) and the 7th Asian Fisheries Forum (Penang). Articles on growing sandfish in earthen ponds, disease and health protocol, in collaboration with a Belgian colleague, and several summarising the project were published, including in the SPC Fisheries Newsletter and the SPC Beche-de-mer Information Bulletin.

## **Project SFS/2001/068: Technical support for regional plant genetic resources development in the Pacific**

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

### **Project background and objectives**

The unique and important diversity maintained in the perennial crop-based production systems of Pacific Island countries is becoming better recognised. In the context of agricultural plant genetic resources (PGR) conservation and use, some collecting, conservation and improvement of PGR (e.g. roots and tubers, bananas, coconuts and breadfruit) has been carried out in the region. This includes the establishment of the Regional Germplasm Centre (RGC) at the Secretariat of the Pacific Community (SPC) and activities funded by the European Union (the EU-funded Pacific Regional Agricultural Programme (PRAP)), INIBAP (the International Network for the Improvement of Banana and Plantain - one of IPGRI's programs), Australia's Department of Primary Industries through SPC, and COGENT (the International Coconut Genetic Resources Network, for which IPGRI provides the facilitation unit). More recent and current 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.

However, it has been observed that progress has so far been made only with a few crops in a limited number of countries. In view of this, in April 1999, ACIAR supported a workshop in Lae, Papua New Guinea (PNG) in order to develop a framework for PGR conservation, management and use in Pacific agriculture. Following this a PGR Working Group was established, consisting of PNG and Fiji, facilitated by SPC. The working group came together and 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. The project is developing complementary conservation strategies (CCS) for agricultural crops of importance in the Pacific Region as a basis for sustainable plant genetic resource (PGR) conservation; including guidelines for the implementation of CCS, and promoting their implementation for high priority agricultural crops.

### **Project progress**

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

*Develop a framework for the establishment of effective sui generis protection of PGR:* An information paper on policies related to PGR for Food and Agriculture, which was reviewed and revised by SPC. The paper was presented at the PAPGREN meeting in May 2003, where it was well received by PICTs. It was thereafter published as an SPC pamphlet, entitled *Policy Issues Related to PGR in the Pacific: A Guide for Researchers and Policymakers*. The English and French versions have been widely distributed in the PICTs to create greater awareness of PGR policy issues. An information paper on the ITPGRFA was also prepared for the September 2004 meetings of Pacific Ministers and Heads of Agriculture and Forestry (HOAFS) <http://spc.int/AC/artAgricultureForestryMeeting.htm>.

*Hold national PGR stakeholder workshops to identify PGR priorities:* Informal consultations were held in 2004 in Solomon Islands, Vanuatu, RMI, Pohnpei, Palau and Kiribati, mainly in conjunction with other meetings and visits. With complementary support from FAO Global Plan of Action (GPA)

implementation monitoring exercises were carried out in Fiji and PNG, with the PGR focal points in these countries and resulted in comprehensive reports on the current PGR situation in the two countries and progress in the 20 priority areas of the GPA.

*Document existing germplasm collections and publish national and regional PGR inventories: A Directory of Plant Genetic Resources Collections in the Pacific Island Countries and Territories* (<http://www.spc.int/pgr/Documents/Databases/Databases.htm>) was published in late 2004 in consultation with national partners and other experts and widely distributed in the region and beyond. The directory also included information on Pacific germplasm held outside the region. This information was forwarded to IPGRI and FAO for updating the information in their databases. The *Directory* is the first fully comprehensive region-wide review of germplasm holdings in the Pacific, and a significant awareness as much as technical product.

*Develop awareness of PGR and of the network:* Four PAPGREN meetings co-funded by NZAID have been held from May 2002 to the present. These have been expensive undertakings, but have proved essential for building up trust and maintaining a collegial atmosphere within the network and stimulating the exchange of information and ideas.

*Train trainers in priority thematic areas on regional basis:* PAPGREN organised a course on PGR documentation in August 2004 at SPC, Suva, Fiji. There were 12 participants from 7 Pacific Island Countries. All participants took home a folder containing a large number of resources, including handouts of the main presentations, descriptor lists and other materials relevant to PGR documentation which was also provided on CD-ROM. The latest PAPGREN meeting concentrated on education and training. PGR practitioners from PNG, RMI, Samoa, Palau, Vanuatu and the Melanesian Farmer First Network detailed their perceived local-level, national and regional needs in the area of PGR education/training/capacity building and this was matched with the expertise available in the region and beyond.

*Support priority conservation activities by National Programmes:* Once the basic structure of the network is in place, national and regional priorities for specific conservation actions on priority crops (<http://www.spc.int/pgr/> and click on "Crops") can be discussed, agreed and implemented.

# Concluded projects

at 30 June 2005

## Bilateral

PHT/1995/136 Cocoa fermentation, drying and genotype product quality assessment 83

## **Project PHT/1995/136: Cocoa fermentation, drying and genotype product quality assessment**

<b>Overseas Collaborating Countries</b>	Papua New Guinea
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Australia
<b>Project Leader</b>	Mr Paul Grieve Phone: 07 33462701 Mobile 0407584377 Email: Paul.Grieve@DPI.QLD.GOV.AU
<b>Collaborating Institutions</b>	Cocoa and Coconut Institute, Papua New Guinea University of New South Wales, Australia
<b>Project Budget</b>	\$639,892
<b>Project Duration</b>	01/01/1998 to 31/12/2004 (Project extended from 01/07/2004 to 31/12/2004)
<b>ACIAR Research Program Manager</b>	Dr Greg Johnson

### **Project background and objectives**

Cocoa is a crop that needs to be fermented and dried before export. How these procedures take place can affect the development of the flavour in the final product. There are many different varieties of cocoa; the choice of plant type can also have an effect on flavours and the physical and chemical attributes that are important to the industry. The type of shell and the fat content are two of the most important features. If these are not within the range desired by the industry, then the cocoa will sell for a lower price or will not find a market.

Preliminary research and development of the technology by the PNG Cocoa and Coconut Research Institute (CCRI) in collaboration with QDPI occurred under previous AusAID-supported research. Cocoa is an important export crop for Papua New Guinea. Technologies that can help ensure that the local cocoa is premium grade are of high priority. Previous work involving the CCRI has shown that fermentation need not necessarily take place in a large processing plant. Smaller scale fermentation, using what is known as a minibox, can allow the growers themselves to prepare smaller volumes of harvested cocoa beans for drying. Fermented, dried cocoa beans sell for more than twice the value of wet beans.

The new technology for drying involves a sun-dryer, which is made of an A-frame of timber and clear laminated plastic sheeting. Black-painted rocks heat up in the sun, and the warm air passes by convection through the drying rack. This technique could replace the current diesel and wood-powered drying kilns. This is particularly important in those cocoa-growing areas where fuelwood is becoming scarce.

Minibox fermentation and solar kiln drying have already been tested at 30 sites in East New Britain in previous research. It was found that, if carried out correctly, the fermentation procedure did not affect the final product. The solar drying resulted in a product with lower levels of acidity and an enhanced chocolate flavour compared to artificially dried samples.

The aim of this project was to evaluate the effectiveness of two novel ways of cocoa fermentation and drying for use by smallholder farmers in Papua New Guinea and to test existing cocoa genotypes to find the ones with the best attributes for the industry.

### **Project outcomes**

The major task was to evaluate the effects of minibox (250 kg) fermentations and solar drying technology on cocoa quality in PNG. Such solar drying technology could lower reliance on diesel and wood-fired kiln drying.

More information was needed about what fermentation processes to employ throughout the country, especially in wetter areas. The project scientists used computer simulation modelling to redesign the solar dryers to optimise their performance for such sites. They investigated the drying properties of cocoa so that they could employ the solar drying technology in the place of kiln and diesel dryers.

They also studied the effects of manipulating fermentations - focusing on length of fermentation, washing the beans prior to drying and the fermentation of smaller quantities of beans than were processed in the existing miniboxes.

On sites shown to be too wet for satisfactory use of solar dryers the project team investigated the feasibility of combination solar/kiln dryers and also provided support to convert existing wood-fired dryers to solar/fuel-fired dryers. In East New Britain (ENB) Province the earlier AusAID project had installed about 50 solar dryers back in 1996, but they had fallen into disrepair. The team decided that rather than just repair them they would modify the design to make them more efficient and less likely to need recurring maintenance. The final design had a concrete base and a flat roof. It showed good performance and had advantages in ease of maintenance and operation. This resulted in a unit that will replace the earlier units in six locations around ENB province.

At CCRI they tested the quality attributes of cocoa lines selected from the breeding program, including lines proposed for provisional release. The team looked for superior attributes such as bean size, shell content and fat content, and demonstrated that the lines for release all produced cocoa of acceptable 'PNG flavour' standard.

The project made possible the involvement of CCRI in an International Cocoa Confectioners' Organization (ICCO) four-country project (PNG, Venezuela, Ecuador and Trinidad & Tobago) on cocoa fine/flavour quality evaluation. The task was to provide comparative documentation of PNG standard fine cocoa for use as a 'bench-mark' against the product from other countries. The initial work was to determine the best fermentation times and roasting protocols for the samples of selected genetic material from the different countries. This was largely completed.

Regardless of the technology that best suits each province, researchers recognised that a key issue was ongoing use and maintenance of the units. Therefore they placed great emphasis on the development of skills and experience amongst extension personnel to encourage the recipients of dryers to better use and maintain them.

CCRI, the PNG Cocoa and Coconut Extension Agency (CCEA) and Cocoa Board staff took part in training and capacity-building activities that involved participatory people-based action learning and paper-based extension materials. This also entailed developing and 'field testing' training materials and user guides for both men and women smallholders.

Part of the project involved drafting suggested revisions to the PNG Cocoa Inspectors and Assessors Manual, the PNG Export Regulations and the PNG Cocoa Act of 1982. One suggested change to Cocoa Board regulations was the phasing out of kiln dryers in provinces and districts in which rainfall levels allow the use of solar dryers. This is to address the issue of smoke contamination, which is the single largest complaint regarding PNG cocoa. This may cause economic hardship to many growers and some type of credit or discounting system may need to be negotiated with the Cocoa Board. A suggested change to the Cocoa Act was to move from the set levy of 40 kina per tonne—originally imposed to finance the Cocoa Board, CCRI and (today) CCEA. Now K40 is worth much less, and the analysts believed it would be better to enter into the Act a formula that relates to the export price of cocoa. The drafts have been presented to the relevant bodies in PNG for them to implement the recommendations.

The project supported CCRI's efforts to develop a PNG brand name chocolate in Australia or PNG. Mars Confectionary Australia, a major user of PNG cocoa, has assisted with the development of chocolate samples.

# Projects under development

at 30 June 2005

## Bilateral

- ASEM/2004/041 Productivity and marketing enhancement for peanut in Papua New Guinea and Australia
- ASEM/2005/090 Sweet potato workshop
- CP/2003/042 Fruit fly management in Papua New Guinea
- CP/2004/064 Biological control of "mile-a-minute" (*Mikania micrantha*) in Papua New Guinea and Fiji
- CP/2004/071 Reducing pest and disease related yield decline in selected PNG sweet potato production systems
- FIS/2002/110 Beche-de-mer fishery management strategies in PNG
- FIS/2004/065 Hatchery, growout and bioremediation prospects for promising indigenous fish species, and bioremediation for barramundi aquaculture in northern Australia and PNG
- FIS/2005/011 Beche de mer Workshop - PNG
- FIS/2005/095 Replenishment of tilapia and carp broodstocks at Aiyura, PNG
- FIS/2005/096 Tuna tagging project, PNG
- FIS/2005/098 Beche de mer workshop, PNG
- FST/2004/050 Value-adding to PNG agroforestry systems
- FST/2004/055 Domestication and commercialisation of indigenous nuts in Papua New Guinea
- FST/2004/061 Assessment and management of cut over native forests in Papua New Guinea
- LPS/2005/094 Local feeds for smallholder poultry production
- PHT/2004/017 Assessment and improvement of quality management during postharvest processing and storage of coffee in Papua New Guinea

## Multilateral

- PHT/2004/047 Sustainable management of coffee green scale in Papua New Guinea

## Other

- SMCN/2004/067 Soil fertility management in PNG

# Papua New Guinea consultations

September 2004

## Indicative Priorities For Aciar Projects: Papua New Guinea

Priorities for collaborative agricultural research and development between Australia and PNG were discussed in Lae and Port Moresby on 6-8 September 2004 at consultations between ACIAR and representatives of relevant PNG Government Departments, Statutory authorities, Research organisations, NGOs and the private sector. Although the priorities have been developed with close reference to the PNG 2003-07 National Medium Term Development Strategy, they are not to be considered as officially sanctioned priorities of the Government of Papua New Guinea. They are priorities expressed by participants at a consultation at a particular point in time. ACIAR will use them as a framework when assessing proposals for collaborative projects, subject to further advice and information from PNG. Researchers intending to seek ACIAR support for collaborative research projects should, in the first instance, approach one of ACIAR's Research Program Managers.

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. ACIAR will work with counterparts to develop institutional capacity, and assist in communication and extension of the results of research. Major changes to the rural environment over 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.

At the consultation, consensus was achieved on several over-arching issues. These include the roles of the private sector, industry bodies and NGOs along with government in research and implementation of research results; 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, farming systems, protection and postharvest technology of crops, fisheries and forestry, with a limited number of projects in animal production and soil management and crop nutrition. The strategy for 2004-08 will emphasise four programmatic thrusts:

- Applied research aimed to maintain and enhance smallholder incomes, with an emphasis on root, plantation and horticultural crops and fisheries. 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

Major **training priorities**, in addition to those offered within projects and through postgraduate degrees, include experimental design and statistical analysis, including management of data quality; research management; research priority setting, monitoring and evaluation, 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.

## Interventions to maintain and enhance smallholder incomes

### *Root and horticultural crops*

- Conservation, characterisation and utilisation of plant genetic resources (sugar, banana, taro, sweet potato, yam)

- Improved productivity and nutrition from smallholder farming systems, especially those based on sweet potatoes and peanuts
- Management of potato late blight
- Assessment and integrated management of pests and diseases of sweet potato and other root crops
- Postharvest handling and storage of sweet potatoes
- Integrated crop management for highland vegetable production
- Alternative crops to highland coffee, including horticultural and floriculture crops
- Market chain analysis (including quality incentives) for key commodities

#### ***Tree crops***

- Cocoa and coffee marketing, quality management and crop protection
- Management of key insect pests and diseases of perennial fruit and tree crops and oil palm, (including fruit flies, banana scab moth and sigatoka disease, leaf hoppers, sago palm grubs and fungal pathogens)

#### ***Village livestock and aquaculture***

- Enhanced productivity of existing inland pond aquaculture systems, and investigation of new opportunities including the domestication of indigenous species.
- Development of cost-effective formulated freshwater aquaculture feeds suited to local production
- Assessment of market options and opportunities for aquaculture production
- Low-cost feeds and feeding systems for chickens and pigs

#### ***Forestry and agroforestry***

- Domestication and improvement of multiple-use, fast-growing indigenous trees species for smallholders and plantation development
- Processing of wood and non-wood products for value adding and local industry development, including utilisation of coconut wood and lesser known species
- Improvement of traditional agro-forestry systems, including fallow rotations, coffee, cocoa, vanilla cover crop management
- Development of lesser-known non-timber forest products for communities (including fruits, nut, fodder, oils and resins)

### **Sustainable management of soil, forestry and fisheries resources**

#### ***Soil***

- Maintenance of soil fertility in response to intensification of land use for annual and plantation crops
- Improving accessibility and usability of soil and land classification systems in PNG for use at both at the field level and in making policy and investment decisions
- Implementation of research into coping strategies to address climatic extremes (drought, frost, excess rainfall) in vulnerable provinces

#### ***Forestry 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

#### ***Fishery resources***

- Simple village level mariculture options for enhanced livelihoods and to provide tools to support sustainable management arrangements for inshore fisheries resources
- Cooperation in the assessment and management of shared fish stocks in Torres Strait and Gulf of Papua
- Review of domestication policies and strategies for the long-line tuna fishery
- Assessment of impacts of fish-attracting device associated tuna fisheries on resource sustainability, particularly the capture of juvenile bigeye and yellowfin tuna

### **Biosecurity**

- Capacity building for diagnosis and integrated management of plant pests, diseases and weeds
- Risk analysis and contingency planning for high-risk plant pests and livestock diseases

### **Institutional capacity building, socio-economics and project assessment**

- Analysis of international comparative market advantage of selected PNG agricultural commodities
- Research addressing social and economic constraints and opportunities in smallholder production systems
- Institutional strengthening strategies for agricultural education and analytical services
- Approaches to research and development project planning frameworks and impact assessment
- Researching alternative approaches to extension

### **Crop Sciences**

- Socio-economics of smallholder tree crop production systems
- Alternative approaches to smallholder tree crop extension and farming systems
- Application of biotechnology to coffee, coconut, cocoa improvement
- Conservation and characterisation of plant genetic resources and development of appropriate regional strategies
- Varietal assessment and agronomy of staple crops (sweet potato, banana, taro)
- Establishment of nutritional analysis for traditional/indigenous PNG crops
- Pest and disease management
  - especially of sweet potato weevil, oribius weevil, pink wax scale, red-banded mango caterpillar, taro beetle, fruit flies, banana scab moth and exotic diseases
  - development of IPM packages for staple and tree crops and introduced vegetables
  - capacity-building in diagnostics and indexing of viruses in PNG
  - application of non-chemical control, including weed biological control

### **Fisheries**

- Management of shared fish stocks in the Torres Strait and Western Province
- Policy development and enhanced productivity of inland fisheries, pond aquaculture, stock enhancement and stocking of lakes and reservoirs
- Management of inshore fisheries resources
  - community management of sedentary resources
  - training/standardisation of resource assessment management and policy tools and methods
  - spillovers from reef mariculture/stock enhancement studies
  - management of Live Reef Fisheries
- Evaluation of past experiences with village-scale and community fishing enterprises

### **Forestry**

- Sustainable management of natural forests, including biology/socioeconomic analysis, approaches for increased wood recovery and utilisation of non-wood forest products
- Plantations
  - restoration/reforestation of degraded upland grasslands
  - domestication for provision of germplasm for both agroforestry and plantation programs
  - genetic improvement of high-value species
- Postharvest processing
  - reduced waste/improved recovery through processing

- preservation methods for improved durability leading to wider utilisation
- Development of information systems for herbarium management and domestication

#### **Land and Water Resources**

- Land management information systems, including the use, development and management of GIS databases, access to information from land-use archives
- Survey-based development of national weed management policy and systems
- Sustainable land management benchmarking through practical technology transfer models from long-term sites
- Nutrient management in intensive vegetable production and to shorten fallows in field crops
- Agroforestry for fallow management, fertility maintenance, and development of economic multiple cropping systems
- Impacts of excessive/deficient soil water from drought or flooding in traditional or innovative cropping systems

#### **Postharvest Technology**

- Market and product quality analysis for domestically-consumed crops and potential export crops
- Reduction of post-harvest losses in domestically-marketed food crops
- Development of processing methods for vanilla, sweet potato and sago
- Enhanced product quality and management of coffee and cocoa processing wastes

# ACIAR publications

This list is a selection of titles from ACIAR's range of scientific publications that are relevant to PNG's agricultural research and development sector. Hard copies are available by emailing [comms@aciar.gov.au](mailto:comms@aciar.gov.au), or may be requested through ACIAR's PNG office. Publications may also be downloaded from ACIAR's website, [www.aciar.gov.au](http://www.aciar.gov.au).

## Monographs

- 06 Chemistry of Tropical Root Crops: significance for nutrition and agriculture in the Pacific
- 12 Biological Control – Pacific Prospects: Supplement 1
- 20 Biological Control – Pacific Prospects: Supplement 2
- 28 The Economics of Papua New Guinea Tuna Fisheries
- 32 Working with Mycorrhizas in Forestry and Agriculture
- 33 Illustrated Guide to the Identification of Banana Varieties in the South Pacific
- 40 Essential Oils of Tropical *Asteromyrtus*, *Callistemon* and *Melaleuca* Species
- 44 The Major Invertebrate Pests and Weeds of Agriculture and Plantation Forestry in Southern and Western Pacific
- 45 Report on ACIAR-Funded Research on Viroids and Viruses of Coconut Palm and Other Tropical Monocotyledons 1985-1993
- 48 Nutrient Disorders of Sweet Potato
- 52 Improving Smallholder Farming Systems in *Imperata* Areas of Southeast Asia
- 54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries
- 58 Understanding Animal Health in Southeast Asia
- 66 A Review of Papua New Guinea's Red Meat Industry
- 76 Plant Genetic Resources in the Pacific
- 80 Setting Policy Priorities for the Development of Tree Crop Industries in Papua New Guinea
- 81 Policy Options for the Tree Crop Industries in Papua New Guinea
- 83 How to Unravel and Solve Soil Fertility Problems
- 85 Fruits of Oceania
- 94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package
- 99 Developing agricultural solutions with smallholder farmers
- 101 The Coconut Odyssey: the bounteous possibilities of the tree of life
- 102 Lantana: Current Management, Status and Future Prospects
- 108 Pig Husbandry in New Guinea: a literature review and bibliography
- 109 Community Based Resource Planning: Studies from Zimbabwe and Northern Australia
- 113 Worm Control for Small Ruminants in Tropical Asia

## Proceedings

- 13 Bacterial Wilt Disease in Asia and the South Pacific
- 53 Coconut Improvement in the South Pacific
- 57 Leucaena - Opportunities and Limitations
- 66 Bluetongue Disease in the Asia-Pacific Region
- 69 South Pacific Indigenous Nuts
- 91 Fire Management
- 97 *Hypsipyla* Shoot Borers in Meliaceae
- 99 Food Security for Papua New Guinea
- 112 Breeding for Drought Resistant Peanuts

## Technical Reports

- 14 Transport of Vegetables in Papua New Guinea
- 15 Marketing Perspectives on a Potential Pacific Spice Industry
- 18 Post-Flask Management of Tissue-cultured Bananas
- 21 Production of Pathogen-tested Sweet Potato
- 50 Mapping Land Resource Potential and Agricultural Pressure in Papua New Guinea

55 Chromolaena in the Asia-Pacific Region

**ACIAR Working Papers**

53 Priorities for Pig Research in Southeast Asia and the Pacific to 2010

56 Agricultural research and poverty alleviation: some international perspectives