



Australian Government
Australian Centre for
International Agricultural Research

ACIAR Country Profiles 2009–10



PAPUA NEW GUINEA

ACIAR Country Profiles 2009–10: Papua New Guinea



ACIAR

Research that works for developing
countries and Australia

www.aciar.gov.au

2009

© Commonwealth of Australia 2009

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to the Commonwealth Copyright Administration, Attorney-General's Department, Robert Garran Offices, National Circuit, Barton ACT 2600 or posted at <<http://www.ag.gov.au/cca>>.

Published by the Australian Centre for International Agricultural Research (ACIAR)

GPO Box 1571, Canberra ACT 2601, Australia

Telephone: 61 2 6217 0500

Email: aciar@aciar.gov.au

ACIAR 2009. ACIAR Country Profiles 2009–10: Papua New Guinea. Australian Centre for International Agricultural Research: Canberra.

ISBN 978 1 921615 63 4 (online)

Contents

1	Overview.....	5
1.1	About ACIAR.....	5
1.2	Capacity building and training.....	7
2	Papua New Guinea chapter from the Annual Operational Plan 2009–10.....	9
2.1	Medium-term strategy.....	9
2.2	Key performance indicators (2009–10).....	9
2.3	Position.....	10
2.4	Relationship to the AusAID PNG strategy.....	11
2.5	Research priorities.....	11
3	Active projects in Papua New Guinea.....	15
3.1	Subprogram 1: Addressing social, cultural and policy constraints to the adoption of agricultural technologies.....	15
3.2	Subprogram 2: Enhancement of smallholder incomes from horticulture and root crops.....	21
3.3	Subprogram 3: Improving smallholder returns from export tree crop production and marketing.....	30
3.4	Subprogram 4: New livelihoods from smallholder fisheries, aquaculture and forestry.....	35
3.5	Subprogram 5: Agricultural biosecurity and sustainable management of forestry and fisheries resources.....	44
4	Projects expected to start in 2009–10.....	57
5	Papua New Guinea chapter from the Annual Report 2008–09.....	58
5.1	Position.....	58
5.2	Achievements.....	58
5.3	Pyrethrum—PNG’s resurgent industry.....	65
6	Projects concluded in 2008–09.....	66
7	Impact Assessment Program.....	97
7.1	Impact assessments undertaken in 2008–09.....	97
7.2	Impact assessments planned for 2009–10.....	99

8	Appendix 1: ACIAR Contacts.....	101
8.1	Country Office	101
8.2	R&D Program.....	101
9	Appendix 2: ACIAR Publications.....	102

1 Overview

1.1 About ACIAR

The Australian Centre for International Agricultural Research (ACIAR) is an Australian government statutory authority that operates as part of the Australian Aid Program within the portfolio of Foreign Affairs and Trade. The core principles of Australia's aid program are:

- accelerating progress towards the Millennium Development Goals
- a recognition that, while economic growth is the most powerful long-term solution to poverty, economic growth will not, by itself, deliver fair and stable societies
- a strong emphasis on the Asia–Pacific, while also increasing our efforts in Africa and South Asia
- an emphasis on the power of education to promote development
- a commitment to continue to improve effectiveness.

These principles guide the aid program in delivering sustainable development gains.

ACIAR was established in 1982 to assist and encourage Australia's agricultural scientists to use their skills for the benefit of developing countries but also to work to resolve Australia's own agricultural problems. It contributes to the aid program objectives of advancing Australia's national interest, poverty alleviation and sustainability. Australia has an exceptionally strong capacity in agricultural research and development, and is also unique amongst developed countries in possessing large agricultural areas in the tropics and subtropics.

ACIAR's corporate mission is to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia, through international agricultural research partnerships. ACIAR's principal goals are to reduce poverty, improve food security and care for the natural resource base for agriculture. To achieve these goals, ACIAR facilitates and supports bilateral research and development activities in a broad range of agricultural areas, including crop production and protection, animal health and animal production, fisheries, forestry, land and water resources management and postharvest technology. ACIAR also commissions studies of the economic and policy issues concerned with the management of agricultural systems and natural resources, and helps partner countries build their capacity to engage with the increasingly global market economy.

Research is not carried out by ACIAR itself. ACIAR plans, funds and manages projects which are carried out by public sector groups including universities, state departments, and other research providers such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), in partnership with their counterparts in developing countries.

ACIAR also administers the Australian Government's contribution to the international agricultural research centres, and links the centres through multilateral projects to Australian research organisations.

ACIAR is structured into the following research program areas:

- Agribusiness (AGB)
- Agricultural Development Policy (ADP)
- Agricultural Systems Management (ASEM)
- Animal Health (AH)
- Crop Improvement and Management (CIM)
- Cropping Systems and Economics (CSE)
- Fisheries (FIS)
- Forestry (FST)
- Horticulture (HORT)
- Land and Water Resources (LWR)
- Livestock Production Systems (LPS)
- Pacific Crops (PC)
- Soil Management and Crop Nutrition (SMCN).

In developing research projects for these regions, ACIAR places emphasis on priorities determined in consultation with partner countries, balancing these against Australia's comparative advantage and capacity to assist.

Our partnership model

ACIAR develops a specific program for each partner country that is aligned with its national agricultural priorities. The programs are developed in close consultation with government and research organisations from the partner country and Australia.

ACIAR's research also closely aligns with the Australian aid program's renewed focus on poverty reduction. It is integrated closely with the Australian 'whole-of-government' aid program strategies for specific regions.

Australia's scientists work within a very strong network of institutions in Australia and partner countries, including CSIRO, federal and state government organisations and universities.

ACIAR's projects are split up into bilateral and multilateral projects. Bilateral projects are led by an Australian organisation, with collaborators in the partner country and Australia. Multilateral projects are led by an international agricultural research centre (IARC), in partnership with other research organisations.

Where we work

ACIAR carries out research in the Asia–Pacific region, and currently has projects in the following regions:

- South-East Asia (Cambodia, East Timor, Indonesia, Laos, Philippines, Thailand, Vietnam: >45% bilateral expenditure)
- Papua New Guinea and the Pacific islands (>20% of bilateral expenditure)

- North Asia (China: <15% of bilateral expenditure)
- South Asia (Afghanistan, Bangladesh, Bhutan, India, Iraq, Pakistan: <15% of bilateral expenditure).

Working internationally

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

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

1.2 Capacity building and training

Building the capacity of agricultural research institutions and researchers in partner countries is one of ACIAR's key priorities. The training program aims to enhance the research capabilities of institutions and individuals involved in ACIAR projects. This also assists in research adoption, productive partnerships and project development.

The ACIAR training program has a budget in 2009–10 of approximately \$6.58 million. It comprises five elements:

- fellowships for postgraduate students (John Allwright Fellowships)
- postgraduate returnee follow-up awards (Returnee Small Project Awards Scheme)
- leadership development opportunities for developing country scientists (John Dillon Memorial Fellowships)
- non-award training (short courses and workshops)
- support for the Crawford Fund, both through management of the Australian Government's contribution (\$0.75 million) and sponsorship of attendees at Masterclasses and other selected training activities.

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

John Allwright Fellowships

The objective of the John Allwright Fellowships is to increase the research and development capacity of ACIAR partner-country institutions. The fellowships are awarded to partner-country researchers involved in an ACIAR project to undertake postgraduate studies in tertiary institutions in Australia. Studies focus on areas related to the topic or theme of the ACIAR project. The ACIAR John Allwright Fellowship scheme accounts for approximately \$5.6 million (this figure includes \$3.5 million from the Australian Agency for International Development; AusAID) of the training program budget in 2009–10.

John Allwright Fellowships in Papua New Guinea

		PhD	MSc/Other
Active	Male	7	7
	Female	2	2
Concluded	Male	5	11
	Female	0	6

Returnee Small Project Awards Scheme

The Returnee Small Project Awards Scheme provides small grants to John Allwright Fellows after they complete postgraduate studies and return to their employers in their home country. The scheme allows Fellows to undertake an activity that continues, or is related to, the ACIAR project in which they are involved. The funding is primarily for developing small-scale research projects, with the intention of catalysing longer-term support and ongoing international collaboration.

John Dillon Memorial Fellowships

John Dillon Fellowships provide career development opportunities in Australia for outstanding mid-career agricultural scientists and economists from ACIAR partner countries. The aim is to develop the leadership skills of Fellows in the area of agricultural research management, agricultural policy and/or extension technologies through exposure to Australian agriculture across a range of best-practice organisations involved in research, extension and policymaking.

Short courses and workshops

A limited number of short courses and workshops are undertaken as part of the training program for people involved in ACIAR projects. Most activities are directly managed by ACIAR, but some are managed by the Crawford Fund. The courses and workshops are presented by both public- and private-sector providers and topics are chosen based on advice from senior officials in partner countries.

On-the-job training

On-the-job training as part of ACIAR projects has been shown to deliver excellent returns in terms of capacity building (in addition to the benefits to farmers). The partnership model for ACIAR projects means that Australian and partner-country scientists are working side by side throughout the life of the project.

2 Papua New Guinea chapter from the Annual Operational Plan 2009–10

2.1 Medium-term strategy

The Australian Centre for International Agricultural Research (ACIAR) program supports the Papua New Guinea (PNG) Government's Medium Term Development Strategy (MTDS) 2005–10, in particular the priorities to promote economic growth in the primary sector, comprising agriculture, forestry and fisheries and to empower smallholders to mobilise their own resources for higher incomes. To achieve these goals, ACIAR facilitates and supports research and development (R&D) activities for efficient use of sustainable resources to enable more productive and sustainable agricultural systems. Emphasis is placed on the social and economic contexts of the research, particularly with respect to involvement of women farmers. There are emphases on plantation crops, root and other horticultural crops, forestry and fisheries. These include exported and domestically traded commodities that generate smallholder income and underpin improved food security and economic development. PNG has several significant competitive advantages in relation to the production of timber. The opportunity exists to develop a timber growing and processing industry many times larger than the current log export industry from primary forests.

The ACIAR program includes tightly linked clusters of projects addressing problems faced by smallholders in major commodities such as sweetpotato, coffee, oil palm and cocoa. Program design also encourages private sector, industry and non-government organisation (NGO) linkages in design and delivery of activities. Through addressing issues of biosecurity and sustainable management of land, forest and fisheries resources, sustainability of renewable resources is encouraged. The program has a strong emphasis on capacity building, with high priority given to both training within projects and postgraduate training. In addition to the project expenditures shown above, about \$1 million is invested by ACIAR annually on training in PNG.

AusAID and ACIAR work closely together in PNG. AusAID co-invests in ACIAR-managed project activities, while ACIAR contributes to relevant AusAID programs, particularly the Agricultural Research and Development Support Facility (ARDSF).

2.2 Key performance indicators (2009–10)

- technologies developed to enhance smallholder livelihoods from sweetpotato through increased crop yields, appropriate management of soil and nutrients, and by improved postharvest handling and marketing
- technology innovation for export tree crops that enhance crop yields and improve postharvest handling and marketing within a sociocultural context that reduces constraints to adoption and improves smallholder livelihoods
- new coffee project scoped to assess the socioeconomic constraints to technology adoption and management of the natural-resource base
- initiatives commenced to secure and promote the availability of high-quality teak germplasm for smallholder plantings and increased involvement in projects of agroforestry-focused NGOs

- strategic approach developed to guide the expansion of inland aquaculture in PNG and quantities and reliable availability of high-quality fingerlings significantly improved
- direct linkages between at least three AusAID-funded ARDSF projects, at least three Unitech scholarship projects and ACIAR research outputs.

2.3 Position

PNG is one of Australia's most important development partners, and ACIAR's program in PNG reflects this. ACIAR's program recognises the many challenges to agricultural development in PNG, including poorly developed infrastructure, weak market signals and services, pressure on land and renewable resources as a result of population increases and new pest and disease threats, and poor product quality. Future impacts of population pressure and HIV/AIDS and other human diseases on the farming sector, including effects on labour availability and productivity, will be addressed, and gender issues will be mainstreamed into the program. Recognising the enormous potential of agriculture for sustaining the basic livelihood of the people, the Papua New Guinea Department of Agriculture and Livestock has developed a National Agriculture Development Plan as a blueprint to guide future directions in agriculture and rural development.

Village-based agriculture supports over 70% 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 sweetpotato, the dominant staple for over 65% of the rural population. The main export tree commodities are timber, oil palm, coffee, cocoa and coconut. Forestry is PNG's third-largest revenue earner and a major contributor to economic and social development. PNG has several significant competitive advantages in relation to the production of timber; available land, good soils and climate, and a long history of successful incorporation of trees into agroforestry systems. The PNG fisheries zone of 2.4 million square kilometres is the largest in the South Pacific. The fisheries zone includes an extended reef system, numerous islands and an extensive coastline. These create huge opportunity but also present an enormous challenge for monitoring and control. The total market value of the PNG catch is estimated at A\$140–160 million. Pigs and poultry are important village animals and there are some live exports of cattle from PNG. ACIAR will assist in the development of capacity to detect and manage infectious disease in the wider context of biosecurity arrangements and in collaboration with other Australian agencies. Where relevant, close linkages will be formed between ACIAR-funded programs in PNG and the Pacific island countries, for example in root and tree crops, fisheries and forestry.

Key principles in designing and executing the program include the importance of:

- engagement with the private sector, industry bodies and NGOs along with government in both research and implementation of research results
- research that assists the engagement of smallholders in the cash economy
- understanding the social and economic issues affecting farmer decision-making and factors influencing adoption of new technologies.

Research is urgently needed into more effective ways of increasing the adoption of R&D results from pilot-level involvement of communities to enable broader implementation. ACIAR will work with its counterparts to assist in communication and extension of the results of research. As well as making a greater commitment to implementation of the results of research, the need for ongoing development of agricultural technologies remains strong.

There is particular need to develop the informal sector (including those involved in village-level production and marketing of root and horticultural crops and small

livestock), improve the productivity of major tree crops (by increasing production and exports and lowering production costs), and support R&D that assists in diversification of the agricultural export product base.

There are requirements for capacity building at both the individual and institutional levels in all areas, but particularly to support analysis of social and economic constraints and opportunities, marketing and value-addition of agricultural products and in agricultural education. PNG's relative lack of human resources is a constraint in R&D activities and delivery of extension services. It is therefore crucial during design and implementation of projects to involve farmers and extension workers, and to include training and packaging of research results in a form useful to farmers, members of industry and policymakers.

2.4 Relationship to the AusAID PNG strategy

AusAID's strategy is to encourage PNG to reduce poverty and promote sustainable development through support for the PNG Government's efforts to implement its Medium Term Development Strategy and Medium Term Fiscal Strategy, with a specific focus on four core areas:

- improved governance and nation building
- sustainable broadbased economic growth and increased productivity
- improved service delivery and stability
- a strengthened, coordinated and effective response to the HIV/AIDS epidemic.

Australia's support to the agriculture sector in PNG contributes directly to the second strategy and is in alignment with the ACIAR program. The main goal of the ACIAR program, including the ACIAR--AusAID Partnership in PNG is to ensure 'sustainable and secure improvements in food supply and rural incomes for smallholders through increased productivity and enhanced access to markets and services (agriculture, forestry, agroforestry, fisheries and aquaculture) and sustainable and secure improvements in food supply and rural incomes'.

2.5 Research priorities

ACIAR has a formal program of consultations with PNG to establish priorities in research collaboration, as well as annual smaller consultations and industry workshops to finetune these priorities. A record of the most recent set of formal consultations, held in May 2008, is provided at <www.aciar.gov.au> under Partner country priorities/Papua New Guinea. The ACIAR PNG portfolio emphasises the disciplines of agricultural systems (including postharvest activities); production and protection of root, horticultural and tree crops; and fisheries and forestry. Training priorities are mainly addressed through targeted activities within projects, although support for postgraduate degrees in Australia and an in-country scholarship scheme at the University of Technology, Lae, are the main contributors to capacity development. The priorities are grouped under the following thematic programs.

Subprogram 1: Addressing social, cultural and policy constraints to the adoption of agricultural technologies

- Interventions to overcome cross-cutting social and cultural constraints to smallholder household profitability/productivity based on analysis of:
 - land mobilisation issues (tenure, registration, titles, communal)
 - applicability of new labour mobilisation models beyond the cocoa and oil palm industries

- impact of smallholder involvement in participatory action research activities and other group learning processes on adoption of technical innovations
- effects of cultural factors on ability to replicate successful entrepreneurship in agriculture
- analysis of income utilisation, savings incentives and microfinance access in smallholder families, particularly with respect to establishing criteria for successful engagement of women
- Analysis of how current production and marketing systems impact on women in terms of efficiency and equity, and the role and effectiveness of women's groups in rural industries
- Assessment of the role of cottage industries in contributing to livelihoods and household cash flow and complementing engagement in formal markets and the national economy
- Economic assessment of the rice trade and rice-based farming systems, including national demand (role of production and imports) and potential returns from investing in technical improvements
- Improved crop water management under climate variability and change, including:
 - management of water availability to meet market demand and food security
 - identification of drought-vulnerable areas for PNG and potential policy and technical interventions.

Subprogram 2: Enhancement of smallholder incomes from horticulture and root crops

- Matching supply to demand and marketing of highland root and horticultural crops, including:
 - understanding the sector to clarify demand of different product categories in major markets
 - understanding relative effectiveness of different collaborative arrangements for mobilising smallholders from social and cultural perspectives
 - economics of storage depots, and the role of private sector versus government intervention
 - establishment of criteria for productive relationships between smallholders, middlemen and private-sector buyers and sellers
- Application of traditional staple crop varieties (sweetpotato, taro and banana) and identification of suitable crop varieties for processed products
- Identification of quarantine barriers to potential export of root crops and flowers to other countries
- Use of legumes and fallow crops for soil-fertility improvement and longer-term nutrient supply in vegetable-production systems
- Analysis and interventions in market chains for temperate vegetables, including collation of market information and strategies to improve postharvest operations
- Assessment of simple technologies and mechanisation systems for family and community production, postharvest handling and storage of horticultural crops

- Improvement of seed multiplication, distribution and marketing systems, including assessment of strategies for enhancing availability of quality seed
- Improved productivity and profitability of sweetpotato-based farming systems, including:
 - development of breeding and selection strategies for important traits in sweetpotato for different regions in relation to yield, stress tolerance and consumer preferences
 - development of integrated pest, disease, weed and nutrient management strategies
 - evaluation of industrial opportunities for processed sweetpotato products
- Identification of promising root crop—legume—tree—livestock systems that provide better use of crop residues for nutrient cycling and local sources of animal feed.

Subprogram 3: Improving smallholder returns from export tree crop production and marketing

- Social and economic analysis of incentives for uptake of intensified management systems in cocoa, coffee and oil palm
- Development and application of geographical information system (GIS) databases for coffee, cocoa and oil palm with a focus on management of pest and disease outbreaks
- Assessment of the impact of cocoa pod borer infestation and potential coffee berry borer infestation on smallholders and implementation of pre-border—postborder spread, incursion management and surveillance
- Development and smallholder implementation of biocontrol systems for major oil palm pests (*sexava*, *Eurycantha*) and diseases (*Ganoderma*)
- Assessment of natural-resource sustainability indicators for tree crop industries
- Management systems for processing wastes from coffee and other tree crops to underpin development of environmentally sustainable production practices required for certain export markets.

Subprogram 4: New livelihoods from smallholder fisheries, aquaculture and forestry

- Use of GIS-based tools that integrate aquaculture into existing land-use systems and socioeconomic contexts
- Small-scale inland aquaculture, including cost-effective feeds and feeding strategies and increased availability of quality fingerlings
- Evaluation of livelihood opportunities in recreational fishing resources such as black bass
- Development of agroforestry systems, addressing:
 - integration of high-value tree crops into agricultural systems
 - germplasm development, delivery and agroforestry demonstration sites
 - social, cultural and economic motivations for landowners planting trees
- Social and economic approaches to improve smallholder involvement in forestry and agroforestry, addressing land tenure and user rights issues and participatory processes to foster community engagement

- Improving economic returns from timber processing, including economic analysis of sawmilling strategies, improving sawn log recovery and use of small-diameter logs from secondary forests.

Subprogram 5: Agricultural biosecurity and sustainable management of forestry and fisheries resources

- Optimising economic, social and environmental returns from planted and native forests, particularly addressing landowner land-use options, product diversification and income-earning opportunities for women
- Climate change and sustainable forest management, including research on transparent instruments to foster landowner involvement in carbon trading (through ACIAR collaboration with whole-of-government programs)
- Reforestation strategies for rehabilitation of degraded areas, including secondary (cut-over) forests, mine sites and grasslands
- Management of shark fisheries, including target (shark longline) and non-target (tuna, purse seine and longline) fisheries
- Responding to overfished inshore fisheries through community-based fisheries management, restocking (especially of sea cucumber) and identification of aquaculture-based livelihoods
- Assessment of future risks, control and potential utilisation strategies for invasive or exotic fisheries species
- Strengthening of surveillance systems to monitor and respond to livestock diseases.

3 Active projects in Papua New Guinea

3.1 Subprogram 1: Addressing social, cultural and policy constraints to the adoption of agricultural technologies

<i>Project number</i>	<i>Project title</i>
ASEM/2005/094	Improving the profitability of village broiler production in Papua New Guinea
ASEM/2006/023	Re-commercialisation of the Papua New Guinea pyrethrum industry and improving harvested yields in Australia
ASEM/2006/127	Commercial sector/smallholder partnerships for improving incomes in the oil palm and cocoa industries in Papua New Guinea
ASEM/2007/096	The policy environment in Papua New Guinea and its impact on the adoption of the outputs of past ACIAR projects
ASEM/2008/042	Postgraduate scholarship scheme at the University of Technology Lae, Papua New Guinea

ASEM/2005/094: Improving the profitability of village broiler production in Papua New Guinea

The village broiler farming sector in PNG imports most feed ingredients, despite a doubling in production costs due to massive devaluation of the kina and transportation cost rises. Suitable local alternatives, such as copra meal, fishmeal and palm-kernel meal are available. Project LPS/2001/077 developed a supplement of fishmeal and copra meal (plus minerals and vitamins) which when combined with 50–80% of local ingredients (e.g. sweetpotato) makes up a whole ration. This project builds on this work to improve broiler production and profitability, developing on-station a range of 'best-bet' feeding options, evaluating on-farm feeding options incorporating local feeds, and promoting their widespread adoption.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

South Australian Research and Development Institute, Pig and Poultry Production Institute, Australia

Project leader

Dr Phil Glatz
Phone: 08 8303 7786
Fax: 08 8303 7689
Email: phil.glatz@sa.gov.au

Collaborating institutions

Christian Leaders Training College, Papua New Guinea
Lutheran Development Service, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
Ok Tedi Mining Ltd, Papua New Guinea
Salvation Army Agricultural Development Program, Papua New Guinea
University of Technology, Papua New Guinea

Project budget

\$429,904

Project duration

01/01/2007 to 30/09/2010
(Project extended from 01/01/2010 to 30/09/2010)

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2005/094>

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

Pyrethrum is an in-demand insecticide extracted from the *Pyrethrum* daisy plant. Its benign properties make it desirable for use as an insecticide in a number of applications. Introduced to PNG in the late 1950s, it formed a major highland industry employing as many as 80,000 people in the late 1980s. Local products were sold to a processing factory with marketing undertaken by the factory owners. The closure of this factory ended the local market, curtailing the industry. Botanical Resources Australia has offered to buy the PNG crop and help re-commercialise the industry. Planting materials and improved agronomic practices, along with research into the adoption of improved production and plant physiological factors, will be undertaken.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Botanical Resources Australia—Agricultural Services Pty Ltd, Australia

Project leader

Mr Brian Chung
Phone: 03 6224 4511
Fax: 03 6224 4473
Email: bchung@pyrethrum.com.au

Collaborating institutions

Department of National Planning and Monitoring, Papua New Guinea
Enga Provincial Administration, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
University of Tasmania, Australia

Project budget

\$801,657

Project duration

01/01/2007 to 31/12/2010

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2006/023>

ASEM/2006/127: Commercial sector/smallholder partnerships for improving incomes in the oil palm and cocoa industries in Papua New Guinea

The project aims to raise smallholder productivity and incomes in the oil palm and cocoa sectors through identifying, refining and promoting effective strategies for commercial-sector partnerships with smallholders. Examples of commercial-sector engagement are the provision of farm management advice/sale of inputs to smallholders, and joint-venture companies between the commercial sector and customary landowner groups that entail various tenancy-type arrangements with conditions of land use. The objectives of the project are to improve extension delivery through greater commercial-sector engagement with smallholders, and to develop effective land-use agreements between the commercial sector and customary landowners. A core component of the project will be to implement innovative payment systems for productivity-enhancing inputs that accommodate the sociocultural context of smallholder production.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Curtin University of Technology, Faculty of Media, Society and Culture, Australia

Project leader

Dr George Curry
Phone: 08 9266 3310
Fax: 08 9266 3166
Email: g.curry@curtin.edu.au

Collaborating institutions

Cocoa Coconut Institute of Papua New Guinea, Papua New Guinea
PNG Oil Palm Research Association Inc, Papua New Guinea
University of Western Sydney, Australia

Project budget

\$744,496

Project duration

01/01/2008 to 31/12/2011

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2006/127>

ASEM/2007/096: The policy environment in Papua New Guinea and its impact on the adoption of the outputs of past ACIAR projects

Government policies, and the quality and reach of institutions (especially those that underpin market transactions and property rights), play a key role in shaping the incentives for primary producers to adopt the outputs of technical research. While ACIAR has previously included studies on policy issues in its portfolio, it is now embarking on a more concerted effort to look at the effect of policy on the probability of its projects having favourable impacts. This work aims to identify strategies for dealing with situations where the policy and institutional environment hinders the adoption of new technologies, or diminishes the benefits of adoption.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Centre for International Economics, Australia

Project leader

Dr Robert Warner
Phone: 02 6245 7800
Fax: 02 6245 7888
Email: Bwarner@TheCIE.com.au

Collaborating institution

Dr Eric Omura, Papua New Guinea

Project budget

\$149,830

Project duration

01/05/2008 to 30/08/2009

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2007/096>

ASEM/2008/042: Postgraduate scholarship scheme at the University of Technology, Lae, Papua New Guinea—phase 2

ACIAR project ASEM/2004/077 *Postgraduate scholarship scheme for Unitech, University of Lae, Papua New Guinea* started in March 2005 and successfully ended in December 2008. During this period, 22 Postgraduate Diplomas (PGDs) and three Masters of Philosophy graduated from the ACIAR scholarship program. During the same period, ACIAR provided new equipment for postgraduate training and research in the Department of Agriculture at Unitech.

A review undertaken in October 2008 recommended that the ACIAR postgraduate scholarship scheme be extended to 2011. This project supports this scheme, with the objectives of providing stipend, fees and research consumables for six ACIAR scholars for PGD training in 2009, three ACIAR scholars for MSc training in 2010 (upgraded from PGDs) and three scholars for PGD training in 2010. The project is also securing experts to provide advice and support for supervising staff and students in the development, execution, analysis and presentation of relevant research projects to complete their training programs.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Technology, Papua New Guinea

Project leader

Professor Abdul Halim
Phone: 675 473 4450
Fax: 675 473 4477
Email: ahalim@ag.unitech.ac.pg

Collaborating institution

Dr Barry W. Norton, Australia

Project budget

\$150,000

Project duration

01/01/2009 to 31/12/2009

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2008/042>

3.2 Subprogram 2: Enhancement of smallholder incomes from horticulture and root crops

Root crops are traditional staple foods in PNG, and their vital contribution to food security is well recognised. However, the production of root crops, in particular sweetpotato, is declining as a consequence of competing land pressure, shortening fallow periods, soil degradation and other factors such as pests and diseases. The project cluster on root crops is designed with these constraints in mind. Its main focus is on identification and development of more productive and sustainable production systems based on root crops. Activities include efficient use of plant genetic resources; identification of promising nutrient, water, pest and disease management practices; and development of improved postharvest-handling techniques. Capacity building and dissemination of promising technologies to farmers are critical and integral components of the program. During 2009–10 a new program of activities on horticultural crops will be implemented.

<i>Project number</i>	<i>Project title</i>
ASEM/2006/035	Improving marketing efficiency and postharvest management and value-addition of sweetpotato in Papua New Guinea
FST/2006/048	Processing of <i>Canarium indicum</i> nuts: adapting and refining techniques to benefit farmers in the South Pacific
PC/2003/029	Management of potato late blight in Papua New Guinea
PC/2005/134 (multilateral)	The use of pathogen-tested planting materials to improve sustainable sweetpotato production in Solomon Islands and Papua New Guinea (CIP)
PC/2006/106	Screening and field trials of high-carotenoid sweetpotato in Solomon Islands and Papua New Guinea to improve human vitamin A status
SMCN/2004/041	Productivity and marketing enhancement for peanut in Papua New Guinea and Australia
SMCN/2004/067	Soil fertility management in the Papua New Guinea highlands for sweetpotato-based cropping systems
SMCN/2004/071	Reducing pest and disease impact on yield in selected Papua New Guinea sweetpotato production systems

ASEM/2006/035: Improving marketing efficiency, postharvest management and value-addition of sweetpotato in Papua New Guinea

Sweetpotato is a major staple food crop in PNG, providing 43% of total dietary intake (as measured by weight and food energy). Annual production is currently 3 million tonnes with 75% of this crop produced in the highlands. As a subsistence crop, most sweetpotato produced in the highlands has been used for home consumption as food and animal feed, but an increasing amount is being sold locally and to the markets in Lae and Port Moresby. Postharvest losses from farm to market are high as a result of poor handling, storage and transportation techniques. Consultation with PNG partners have identified consumer preferences, marketing and postharvest management of sweetpotato as priority research areas that need to be addressed. The Australian potato industry also faces similar postharvest losses, particularly through rot and breakdown during export. This project has two components: one in PNG focused on the sweetpotato supply chain, and one in Australia focused on the potato supply chain. It aims to improve the livelihoods of farmers and other participants in the supply chains by improving marketing efficiency, postharvest management and value-addition.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Canberra, Australian Institute for Sustainable Communities, Australia

Project leader

Dr Christie Chang
Phone: 02 6773 2855
Fax: 02 6773 3596
Email: christie.chang@canberra.edu.au

Collaborating institutions

Fresh Produce Development Agency Ltd, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
New South Wales (NSW) Department of Industry and Investment, Australia
NSW Department of Primary Industries, Australia
Rural Women's Development Initiative, Papua New Guinea

Project budget

\$947,871

Project duration

01/01/2008 to 31/12/2010

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2006/035>

FST/2006/048: Processing of *Canarium indicum* nuts: adapting and refining techniques to benefit farmers in the South Pacific

Canarium indicum nuts are marketable products with great potential to improve the livelihoods of rural households in the South Pacific. At the moment, the canarium nut industry is small in world terms, but there is strong consumer demand and acceptance of the product in Papua New Guinea, Solomon Islands and Vanuatu. In these countries, there is great potential for expansion of the domestic markets and developing an export market. A major constraint to increased commercialisation of the *C. indicum* industry is poor quality of the nuts due to postharvest handling and processing. This project is aimed at the development of postharvest handling and processing techniques that optimise quality, while being appropriate for small-scale agriculture. The project will take advantage of expertise and experience in the Australian macadamia industry.

Overseas collaborating countries

Papua New Guinea, Vanuatu

Commissioned organisation

University of the Sunshine Coast, Faculty of Science, Health and Education, Australia

Project leader

Dr Helen Wallace
Phone: 07 5430 1228
Fax: 07 5430 2881
Email: hwallace@usc.edu.au

Collaborating institutions

Department of Forests, Vanuatu
Hidden Valley Plantations, Australia
Kava Store Anabrou/Pacific Nuts Co., Vanuatu
Macro Agribusiness Consultants Pty Ltd, Australia
National Agricultural Research Institute, Papua New Guinea

Project budget

\$651,776

Project duration

01/01/2008 to 31/12/2010

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2006/048>

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

Subsistence farmers, making up the majority of farmers in PNG, rely on potato as an important food source. For some smallholders, it is their main crop. The 'English' potato is the main type grown. In 2003, an outbreak of potato late blight believed to be caused by a new and virulent strain of *Phytophthora infestans* spread rapidly through potato-growing regions. Since then, many varieties have not been grown, due to the cost of weekly fungicide treatments. Confirmation of the new strain or strains causing potato late blight is being sought by the project team, to identify blight-tolerant varieties. Cost-effective controls, using integrated control strategies, are also being investigated.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Department of Primary Industries, Victoria, Knoxfield Centre, Australia

Project leader

Dr Rudolf De Boer
Phone: 03 9210 9222
Fax: 03 9800 3521
Email: dolf.deboer@dpi.vic.gov.au

Collaborating institutions

Cooperative Research Centre(CRC) for Tropical Plant Protection, Australia
Fresh Produce Development Company Ltd, Papua New Guinea
International Potato Center, Peru
National Agricultural Research Institute, Papua New Guinea
Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea

Project budget

\$918,109

Project duration

01/11/2004 to 31/10/2009

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2003/029>

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

In PNG and Solomon Islands, yield decline has been recorded in sweetpotato varieties over time. Introducing and adapting technologies that produce consistently high-yielding and nutritious crops of sweetpotato can help to satisfy household consumption, improve human nutrition and supply domestic markets. This project will describe and evaluate sweetpotato seed supply systems, introduce and evaluate improved varieties, then introduce, refine and disseminate technologies for improved supply systems of sweetpotato seed for smallholders practising low-input agriculture.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

International Potato Center, East and Southeast Asia and the Pacific Regional Office, Indonesia

Project leader

Dr Fernando Ezeta
Phone: 62 22 278 5586
Fax: 62 22 278 5549
Email: F.Ezeta@cgiar.org

Collaborating institutions

Department of Agriculture and Livestock, Solomon Islands
Department of Employment, Economic Development and Innovation, Australia
Kastom Gaden Association, Solomon Islands
National Agricultural Research Institute, Papua New Guinea
Queensland Department of Primary Industries and Fisheries, Australia

Project budget

\$849,742

Project duration

01/09/2006 to 31/08/2010

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2005/134>

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

Many people in Solomon Islands and PNG do not receive enough dietary vitamin A, which is vital in boosting immunity to disease. Vitamin A supplementation of infants in PNG reduced the effects of malaria, but it would be preferable to receive enough vitamin A through the diet. The orange sweetpotato (OSP) is a nutritionally enhanced staple containing among the highest concentrations of beta-carotene (the major pro-vitamin A carotenoid) of any food—as little as 100 grams per day can prevent vitamin A deficiency. This activity is surveying promising coloured Solomon Island and PNG sweetpotato cultivars for carotenoids; in particular beta-carotene. It is also examining the cultural and social dimensions of sweetpotato in the diets in Solomon Islands and PNG, to determine how to promote OSP as a healthy dietary component and to increase its consumption. As well, it will introduce improved OSP cultivars and compare them with the highest-carotenoid local cultivars.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

University of Adelaide, School of Agriculture, Food and Wine, Australia

Project leader

Dr Graham Lyons
Phone: 08 8303 6533
Fax: 08 8303 7109
Email: graham.lyons@adelaide.edu.au

Collaborating institutions

Department of Agriculture and Livestock, Solomon Islands
International Potato Center, Indonesia
Kastom Gaden Association, Solomon Islands
National Agricultural Research Institute, Papua New Guinea

Project budget

\$131,000

Project duration

01/02/2007 to 31/01/2010

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2006/106>

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

Peanut is an important cash crop in PNG. Trials carried out in an earlier ACIAR project (ASEM/2001/055) identified promising varieties with potential to yield 50–100% more than the local varieties. This project follows on to transfer new varietal and associated management technologies to smallholders to help enhance the markets for, and marketability of, new peanut varieties. Smallholder farmers will be involved in evaluating the most suitable varieties and management practices. Suitable varieties will be multiplied and disseminated. A 40% increase in peanut production in Morobe and Eastern Highland provinces should result in PNG kina (K)4.5 million per annum additional net income at current market prices.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Department of Employment, Economic Development and Innovation, Australia

Project leader

Dr Rao C.N. Rachaputi
Phone: 07 4160 0737
Fax: 07 4162 3238
Email: rao.rachaputi@deedi.qld.gov.au

Collaborating institutions

Department of Agriculture and Livestock, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
Ramu Sugar Limited, Papua New Guinea
Trukai Industries, Papua New Guinea

Project budget

\$844,422

Project duration

01/01/2006 to 30/11/2009
(Project extended from 01/07/2009 to 30/11/2009)

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Website

<www.aciar.gov.au/project/SMCN/2004/041>

SMCN/2004/067: Soil fertility management in the Papua New Guinea highlands for sweetpotato-based cropping systems

Population growth of 2–3% in the PNG highlands is placing unprecedented pressure on the land resource and on the long-term productivity of sweetpotato, the main staple. An earlier study confirmed the potential for improving productivity of sweetpotato-based systems by addressing soil fertility as a major factor in yield decline. There is also a clear farmer awareness of the problem and interest in becoming engaged. This project will assess and quantify soil and water processes in highland soils, work with farmers to develop and implement improved nutrient and water management options for sweetpotato-based cropping systems (with a focus on existing indigenous soil-management systems), and enhance PNG's soil-research capacity.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Queensland, School of Land and Food Sciences, Australia

Project leader

Dr Neal Menzies
Phone: 07 3365 2059
Fax: 07 3365 2968
Email: N.Menzies@uq.edu.au

Collaborating institutions

Department of Employment, Economic Development and Innovation, Australia
Lutheran Development Service, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
Queensland Department of Primary Industries and Fisheries, Australia

Project budget

\$1,166,270

Project duration

01/04/2007 to 31/03/2012

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Website

<www.aciar.gov.au/project/SMCN/2004/067>

SMCN/2004/071: Reducing pest and disease impact on yield in selected Papua New Guinea sweetpotato production systems

Sweetpotato is the most important food staple in Papua New Guinea, accounting for 60% of dietary calories. Mainly grown by subsistence farmers, excess production can also be sold or marketed for cash. Despite this importance, yields have been declining for some time, due to the combination of pests, diseases and physiological factors. An integrated pest management (IPM) scheme would aid in reducing pest and disease losses. A pathogen-tested scheme for planting material will be incorporated into the IPM scheme. Linking both should ensure that the impacts of pests and diseases are reduced, particularly with farmers participating in technology development to support the scheme.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Department of Employment, Economic Development and Innovation, Australia

Project leader

Mr Michael Hughes
Phone: 07 4091 9404 mobile: 0427 602 156
Fax: 07 4095 8258
Email: michael.hughes@deedi.qld.gov.au

Collaborating institutions

Fresh Produce Development Agency, Papua New Guinea
International Potato Center, Peru
National Agricultural Research Institute, Papua New Guinea
National Agriculture Quarantine and Inspection Authority, Papua New Guinea
Queensland University of Technology, Australia

Project budget

\$905,775

Project duration

01/04/2006 to 31/03/2010

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Website

<www.aciar.gov.au/project/SMCN/2004/071>

3.3 Subprogram 3: Improving smallholder returns from export tree crop production and marketing

Cocoa and oil palm

The scope for smallholder productivity and income improvements within the export tree sector is large in PNG. There are approximately 150,000 families producing cocoa at very low levels of productivity, and over 18,000 smallholder growers producing oil palm at less than 50% of plantation capacity. If productivity were to rise by even a small margin, the income gains would be significant for smallholders, their families and their communities. This can only be achieved through improvements in smallholder crop husbandry skills, application of fertiliser and management of soil fertility. The main aim of this cluster of projects is to raise smallholder productivity and incomes in the oil palm and cocoa sectors while sustaining the natural-resource base. This will be achieved through identification of promising management practices to increase crop productivity, development of measurable and quantifiable environmental indicators of sustainability and promotion of effective strategies for commercial-sector partnerships with smallholders.

<i>Project number</i>	<i>Project title</i>
ASEM/2006/127	Commercial sector/smallholder partnerships for improving incomes in the oil palm and cocoa industries in Papua New Guinea (see Subprogram 1 for summary)
PC/2007/039	The control of basal stem rot of oil palm caused by <i>Ganoderma</i> in Solomon Islands

Coffee

The PNG coffee industry supports over 350,000 families and earns K300 million (A\$120 million) annually, but the consistency and reliability of coffee supply and quality has declined with the move to low-input management of the smallholder industry. Despite this general decline, premium PNG coffee retains a good reputation among customers and there is good scope to increase demand by improving marketing and quality. ACIAR's coffee program cluster aims to increase the profitability of coffee production for smallholders through optimising the cost and adequacy of production inputs, improving reliability of supply and quality, processing for quality and exploring a range of alternative marketing approaches.

<i>Project number</i>	<i>Project title</i>
ASEM/2008/035	Scoping study to examine the state of coffee resources and socioeconomics in Papua New Guinea

Fisheries and aquaculture

Inland fish farming is expanding rapidly in PNG, with an estimated 11,000 smallholder farmers contributing an annual production valued at A\$2.5 million. Key constraints include poor fingerling supply compounded by inefficient distribution channels (which limit the availability of seed to farmers), the high cost and limited availability of suitable feeds, and a general lack of aquaculture husbandry skills and knowledge. The projects are interlinked and collectively aim to improve the productivity of fish farmers in inland PNG through increasing the supply of fingerlings to farmers; improving available feeding options, including on-farm feed production and the development and distribution of simple formulated feeds based on locally available materials; conducting dedicated training programs and strategies to increase farmer skills in pond husbandry; and investigating alternative culture species, with an emphasis on promising indigenous fish and crustaceans.

<i>Project number</i>	<i>Project title</i>
FIS/2008/031	An assessment of the extent of genetic introgression in exotic culture stocks of tilapia in the Pacific

PC/2007/039: The control of basal stem rot of oil palm caused by *Ganoderma* in Solomon Islands

Basal stem rot, caused by the wood-rotting fungus *Ganoderma boninense*, is a disease that reduces oil palm yields in most production areas of the world. Where incidence increases progressively, it slowly but inevitably erodes the profitability of this major industry. In 1997, it was identified as a major threat to the oil palm industry in Solomon Islands, and subsequently in 1998, the Papua New Guinea Oil Palm Research Association initiated a research program (funded by the European Union) that recorded disease levels in some blocks as high as 43%. The disease compromises the future sustainability of the industry in Solomon Islands, and the recommended strategy for long-term control is to implement improved cultural practices and use more resistant planting material. This project will implement and monitor a short-term control program amongst smallholders in Solomon Islands, and establish progeny trials to identify suitable seed lines for planting in a high-risk environment. It will also determine the most appropriate cultural methods to minimise disease levels in subsequent planting cycles. The scientists predict implementation of a short-term control program within 2 years, and selection of more appropriate planting techniques within 6 years. In 5–10 years, with the most susceptible progeny identified and eliminated from breeding programs, more suitable (disease-resistant) material will be available for replanting. The results from this research will be applicable throughout the Pacific region as well as in the major areas of oil palm cultivation in South-East Asia.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

University of Queensland, School of Land, Crop and Food Sciences, Australia

Project leader

Associate Professor Ian Godwin
Phone: 07 3365 2141
Fax: 07 3365 1177
Email: i.godwin@uq.edu.au

Collaborating institutions

Guadalcanal Plains Palm Oil Limited, Solomon Islands
Ministry of Agriculture and Livestock, Solomon Islands
PNG Oil Palm Research Association Inc, Papua New Guinea

Project budget

\$817,371

Project duration

01/06/2009 to 31/05/2013

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2007/039>

ASEM/2008/035: Scoping study to examine the state of coffee resources and socioeconomics in Papua New Guinea

Production of coffee and fresh food accounts for over half of all cash income in PNG. Coffee income enables smallholder households to pay for medical and education expenses and to meet important social and cultural obligations. Coffee plantation production has declined since the 1980s, while smallholders have steadily increased their share to over 85% of total national coffee production. At the same time, smallholder yields have fallen and coffee quality remains poor. Some of the higher-level structural constraints on smallholder coffee production include poorly developed transport infrastructure and telecommunications, high transport costs, lack of investment, lack of access to credit and banking services, land-tenure disputes and law-and-order problems.

The objective of this small research activity is to identify key areas where future research could improve the livelihoods of smallholder coffee producers in highland PNG. Through a combination of meetings and workshops with various industry stakeholders and a review of secondary data sources, the project team will assess potential research activities, particularly in the areas of socioeconomics, natural resource management practices and communication and technology transfer amongst various stakeholder groups—including farmers, the Coffee Industry Corporation/Coffee Research Institute and exporters. The final report will provide a design framework for future research.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Curtin University of Technology, Department of Social Sciences and Asian Languages, Australia

Project leader

Dr George Curry
Phone: 08 9266 3310
Fax: 08 9266 3166
Email: g.curry@curtin.edu.au

Collaborating institutions

CSIRO Land and Water, Australia
Mr Anthony Marsh, Australia
PNG Coffee Industry Corporation, Papua New Guinea

Project budget

\$49,750

Project duration

01/02/2009 to 31/08/2009

ACIAR Research Program Manager

Dr Caroline Lemerle

FIS/2008/031: An assessment of the extent of genetic introgression in exotic culture stocks of tilapia in the Pacific

Freshwater aquaculture in Pacific island nations (PINs) began in the 1950s. The indigenous freshwater fish fauna in PINs has limited biodiversity, so non-native species were introduced for culture. Introduction of Mozambique tilapia (*Oreochromis mossambicus*) in the 1950s paved the way for introductions of Nile tilapia (*Oreochromis niloticus*) strains in the 1980s. The Genetic Improvement of Farmed Tilapia (GIFT) program was initiated in the Philippines in the 1990s to address issues of declining stock quality and GIFT stocks were distributed to a number of developing nations, including Fiji as part of ACIAR projects. The number of operating farms in Fiji has increased to about 200, but the quality of farmed stocks is unknown. In PNG, stocks of GIFT tilapia were introduced in the late 1990s, but only small numbers of brood-stock survived and all GIFT in PNG are their progeny. Since 2005, an ACIAR project has distributed improved fingerlings and feed to farmers across PNG, however general quality of tilapia in PNG varies, and the genetic structure of PNG populations needs to be studied. Genetic analysis of tilapia from Samoa, Vanuatu, Nauru and Solomon Islands would also provide evidence of the extent of hybrid introgression across the Pacific. This project seeks to pool the resources of Fiji, PNG, Solomon Islands, Vanuatu and Samoan fisheries researchers to achieve a rapid improvement in tilapia culture in the region. A stock of uncontaminated GIFT tilapia is available at WorldFish Centre as a reference for quality. The project will adopt a population genetics approach to identify the extent of *O. mossambicus* introgression in cultured *O. niloticus* stocks in the region and to assess relative levels of genetic diversity in culture stocks of PINs.

Overseas collaborating countries

Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu

Commissioned organisation

Queensland University of Technology, School of Natural Resource Sciences, Australia

Project leader

Dr Peter Mather
Phone: 07 3138 1737
Email: p.mather@qut.edu.au

Collaborating institutions

Ministry of Fisheries and Forests, Fiji
National Fisheries Authority, Papua New Guinea
Secretariat of the Pacific Community, New Caledonia

Project budget

\$148,675

Project duration

15/06/2009 to 14/06/2010

ACIAR Research Program Manager

Dr Chris Barlow

Website

<www.aciar.gov.au/project/FIS/2008/031>

3.4 Subprogram 4: New livelihoods from smallholder fisheries, aquaculture and forestry

<i>Project number</i>	<i>Project title</i>
FIS/2004/065	Culture of promising indigenous fish species and bioremediation for barramundi aquaculture in northern Australia and Papua New Guinea
FIS/2006/138	Developing aquaculture-based livelihoods in the Pacific islands region and tropical Australia

Forestry and agroforestry

ACIAR's PNG forestry project cluster promotes the development of a smallholder- and community-based plantation industry with high-value species. This is based on significant domestic processing, involving both portable sawmills and static production facilities, together with enhanced production of non-timber forest products and services. Species addressed in this work include teak (*Tectona grandis*), canarium (or galip) nuts (*Canarium indicum*) and balsa (*Ochroma lagopus*).

<i>Project number</i>	<i>Project title</i>
FST/2004/050	Value-adding to Papua New Guinea agroforestry systems
FST/2006/120	Increasing downstream value-adding in Papua New Guinea's forest and wood products industry
FST/2004/055	Domestication and commercialisation of <i>Canarium indicum</i> in Papua New Guinea
FST/2006/088	Promoting diverse fuelwood production systems in Papua New Guinea
FST/2007/078	Development of a Papua New Guinea timber industry based on community-based planted forests: design and implementation of a national germplasm delivery system
FST/2009/012	Identification of researchable issues underpinning a vibrant balsa wood industry in Papua New Guinea

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

Locally available protein sources for highland subsistence farmers in PNG are limited. Production constraints minimise cash purchases of protein sources. One potential solution is aquaculture of suitable freshwater native fish and crustaceans. Earlier exploratory research identified possible species for aquaculturing, based on techniques developed for freshwater species, such as barramundi, by the Queensland Department of Primary Industries and Fisheries (QDPIF). Proving hatchery production and grow-out techniques for these species in PNG highland ponds, and fostering extension through Ok Tedi Mining Ltd, now a major employer but due to close in 2012, will be undertaken. On-farm trials with farmers will be used to test these techniques. An Australian component will examine environmental impacts and their management for barramundi farming in Queensland.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Department of Employment, Economic Development and Innovation, Australia

Project leader

Dr Evizel Seymour
Phone: 07 4092 9913
Fax: 07 4093 3903
Email: evizel.seymour@dpi.qld.gov.au

Collaborating institutions

James Cook University, Australia
National Fisheries Authority, Papua New Guinea
Ok Tedi Mining Ltd, Papua New Guinea
Western Provincial Administration, Papua New Guinea

Project budget

\$781,587

Project duration

01/06/2006 to 30/06/2011

ACIAR Research Program Manager

Dr Chris Barlow

Website

<www.aciar.gov.au/project/FIS/2004/065>

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

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

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

The specific objectives are to: identify and implement targeted research activities and technology transfer in response to priority issues identified by Pacific island countries, where possible by drawing on results and expertise developed through completed and on-going ACIAR, WorldFish and other aquaculture projects; increase institutional capacity amongst Pacific island countries to support and manage research, particularly Papua New Guinea; and provide technical support for Indigenous Australian aquaculture ventures.

Overseas collaborating countries

Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu

Commissioned organisation

James Cook University, School of Marine and Tropical Biology, Australia

Project leader

Professor Paul Southgate
Phone: 07 4781 5737
Fax: 07 4781 4585
Email: paul.southgate@jcu.edu.au

Collaborating institutions

Secretariat of the Pacific Community, New Caledonia
University of the South Pacific, Fiji
WorldFish Center, New Caledonia

Project budget

\$1,229,662

Project duration

01/10/2007 to 30/09/2011

ACIAR Research Program Manager

Dr Chris Barlow

Website

<www.aciar.gov.au/project/FIS/2006/138>

FST/2004/050: Value-adding to Papua New Guinea agroforestry systems

Everywhere in PNG, tree growing and management of trees are incorporated into both traditional and modern farming systems. However, because there has been little incentive to focus on species of commercial forestry value, often such species are ignored. Where a critical mass of resource can be established, commercial tree growing appears a good prospect for landowners with limited income-generation alternatives. An ACIAR pilot project earlier identified suitable candidate regions and partners, together with tree species and production systems. This project aims to encourage the adoption of commercial-scale high-value tree growing in PNG, developed through a relationship fostered between landowners and selected business partners.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Australian National University, School of Resources, Environment and Society,
Australia

Project leader

Professor Peter Kanowski
Phone: 02 6125 2667
Fax: 02 6125 0746
Email: peter.kanowski@anu.edu.au

Collaborating institutions

Papua New Guinea Ecoforestry Forum, Papua New Guinea
Papua New Guinea Forest Authority, Papua New Guinea
Papua New Guinea Sustainable Development Program Ltd, Papua New Guinea
Papua New Guinea University of Technology, Papua New Guinea
Village Development Trust, Papua New Guinea

Project budget

\$912,087

Project duration

01/04/2007 to 31/03/2011

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2004/050>

FST/2006/120: Increasing downstream value-adding in Papua New Guinea's forest and wood products industry

PNG's forest industry, based largely on the export of logs from primary forests, is a significant contributor to the national economy. But accessible forests are rapidly being depleted, and the earnings from the logging of primary forests will dwindle over the next 10–15 years. Still, PNG enjoys some significant competitive advantages in relation to the production of timber, and it is possible to envisage a major national industry based substantially on smallholder agroforestry plantings and community-based management of secondary forests. In particular, if coupled with a significant domestic processing industry, this industry could become a much larger contributor to the national economy than the current log export industry. The aim of this project is to provide the foundation for a more extensive and more sophisticated domestic timber-processing industry in PNG—by exploring the development of various products and designs based on solid wood and veneers, by examining the potential for value chains to integrate advanced processing with production of timber in smallholder agroforestry systems and community-managed secondary forests, and by enhancing capacity in timber-processing training, education and R&D.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Melbourne, Faculty of Land and Food Resources, Australia

Project leader

Professor Peter Vinden
Phone: 03 8344 5238
Fax: 03 9349 4172
Email: p.vinden@unimelb.edu.au

Collaborating institutions

Engineered Wood Products Association of Australasia, Australia
Papua New Guinea Forest Industries Association, Papua New Guinea
Papua New Guinea Forest Products Ltd, Papua New Guinea
Papua New Guinea Forest Research Institute, Papua New Guinea
Timber and Forestry Training College of the Papua New Guinea University of Technology, Papua New Guinea
Village Development Trust, Papua New Guinea
University of Technology, Papua New Guinea

Project budget

\$682,816

Project duration

01/01/2008 to 31/12/2010

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2006/120>

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

A feasibility study of domesticating and commercialising the canarium nut (also known as galip nut) in PNG affirmed the positive attributes of the nut of *Canarium indicum*—a high value, nutritious, premium product, with good processing attributes. An industry could be built on traditional use, existing markets and recognised livelihood benefits. Nuts are easy to store, and processing is simple. A large tree-to-tree variability in key kernel traits emphasises the potential for cultivar selection. The soft nut texture is popular and allows a broad range of uses in confectionery/baking, and the nuts have health attributes, making them a part of healthy living in Melanesia. A survey underscored the benefits of developing an industry in Melanesia. All rural people surveyed use canarium nut as a food, with 80% wanting more. With 2 million people consuming 2 kilograms per annum, domestic consumption could be 4,000 tonnes (A\$100 million). The researchers recognised opportunities for year-round production in Melanesia, with growing urban markets in PNG, Solomon Islands and Vanuatu. There was great enthusiasm among producers, traders and tourist outlets in the region, with opportunities for regional and international niche-market expansion. This project aims to seek out, characterise, select and multiply individual *Canarium* trees in PNG that have superior commercial traits for cultivar development and field tests. It also aims to improve market prospects for these products in PNG, Solomon Islands and Vanuatu, deliver selected cultivars and training to the participating communities, and disseminate information to stimulate adoption.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

James Cook University, Agroforestry and Novel Crops Unit, Australia

Project leader

Dr Jonathan Cornelius

Phone: 07 4042 1789; Email: jonathan.cornelius@jcu.edu.au

Collaborating institutions

Cocoa and Coconut Institute, Papua New Guinea

Commodities Export Marketing Authority, Solomon Islands

Kastom Gaden Association, Solomon Islands

National Agricultural Research Institute, Papua New Guinea

Pacific Nuts Co., Vanuatu

Project budget

\$634,571

Project duration

01/01/2006 to 31/12/2009

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2004/055>

FST/2006/088: Promoting diverse fuelwood production systems in Papua New Guinea

Fuelwood is a crucial, but undeveloped, component of the domestic economy of PNG. Fuelwood plantations could directly enhance smallholder income and provide a pathway for rehabilitating grasslands. The main aim of this project is to establish a national fuelwood economy based on woodlots and agroforestry systems.

Underpinning objectives are to describe and quantify the national fuelwood market, to establish in both lowland peri-urban and highland rural regions a range of fuelwood-production systems as pilot projects, and to establish a community of practice which will ensure the wider adoption and long-term development of fuelwood production. Such a system will enable creation of business opportunities to supply a growing fuelwood market while at the same time providing opportunities to produce other products including seedlings, poles and fodder.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Adelaide, School of Agriculture, Food and Wine, Australia

Project leader

Dr Ian Nuberg
Phone: 08 8303 7729
Fax: 08 8303 7979
Email: ian.nuberg@adelaide.edu.au

Collaborating institutions

Ensis, Australia
Foundation for People and Community Development Inc., Papua New Guinea
HOPE worldwide, Papua New Guinea
Papua New Guinea Forest Research Institute, Papua New Guinea
People's Action for Rural Development, Papua New Guinea
W.R. Carpenter & Co. Estates Ltd, Papua New Guinea

Project budget

\$923,079

Project duration

01/01/2008 to 31/12/2011

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2006/088>

FST/2007/078: Development of a Papua New Guinea timber industry based on community-based planted forests: design and implementation of a national germplasm delivery system

The production of high-quality timber and other forest products from planted trees and forests represents an important development opportunity for PNG. Community-based planted forests can generate significantly greater local and national economic benefits than the current natural-forest-based industry. This project addresses an important constraint to the development of such an industry—the lack of adequate supplies of timber tree germplasm. The germplasm shortage results from a scarcity of accessible, good-quality sources as well as difficulties in delivering any available seeds or planting stock from source to end user. The project team will work in three project hubs to develop a model approach to germplasm production and delivery—one suitable for post-project scaling-up (within-hub) and scaling-out (to new hubs). Teak has been selected as the focal species, due principally to its high commercial value and demand, heightened local interest in its cultivation, and proven suitability to lowland PNG conditions. Other socioeconomic and technical constraints will be addressed by companion projects FST/2004/050 (addressing socio-economic impediments and plantation management) and FST/2006/120 (enhancing timber-processing capability).

Overseas collaborating country

Papua New Guinea

Commissioned organisation

James Cook University, Agroforestry and Novel Crops Unit, Australia

Project leader

Dr Jonathan Cornelius
Phone: 07 4042 1789
Fax: 07 4042 1319
Email: jonathan.cornelius@jcu.edu.au

Collaborating institutions

CSIRO Plant Industry, Australia
Foundation for People and Community Development Inc., Papua New Guinea
Ok Tedi Development Foundation, Papua New Guinea
Organisation for Industrial, Spiritual and Cultural Advancement, Papua New Guinea
Pacific Island Projects, Papua New Guinea
Papua New Guinea Forest Authority, Papua New Guinea
University of Vudal, Papua New Guinea

Project budget

\$1,009,755

Project duration

01/06/2009 to 31/05/2014

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2007/078>

FST/2009/012: Identification of researchable issues underpinning a vibrant balsa wood industry in Papua New Guinea

Balsa (*Ochroma lagopus*) is a lightweight wood that possesses a very high stiffness-to-strength ratio, making it valuable in high-grade laminates in composite aluminium and carbon-fibre products for the defence industries, for blades for wind turbines and in the marine and aerospace industries. The species was introduced to PNG in the 1930s, and now is the basis of a small, emerging commercial industry on the Gazelle Peninsula, East New Britain province. Five hundred smallholder growers and two larger commercial interests cultivate around 5,000 hectares on 5-year rotations. Exports of balsa from PNG were valued at over K10 million in 2007 and the dominant markets were China and India. This scoping study seeks to protect the interests of smallholder growers and processors of balsa by identifying researchable issues associated with current opportunities and threats offered to the industry. The output of the study will be a report that includes the following: 1. an overview of PNG's balsa industry and its position internationally; 2. identification and analysis of issues that could influence the continued viability of the industry or present impediments to its expansion across the whole value chain; 3. a review of relevant activities of other agencies in PNG, including commercial organisations, international donors and NGOs; 4. an assessment of the utilisation of balsa wood and the nature and permanence of these markets, compiled via industry interviews and discussions with research agencies; and 5. a synthesis of prioritised researchable issues, and their significance as impediments or threats.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Salwood Asia Pacific Pty Ltd, Australia

Project leader

Mr Stephen Midgley
Phone: 02 6161 5906
Email: stephen.midgley@salwood.com

Collaborating institutions

Four Scenes Pty Ltd, Australia
Mr Alan Brown, Australia
Mr Tommy Kosi, Papua New Guinea
University of Vudal, Papua New Guinea

Project budget

\$59,910

Project duration

01/05/2009 to 31/08/2009

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2009/012>

3.5 Subprogram 5: Agricultural biosecurity and sustainable management of forestry and fisheries resources

Many of the agricultural pests and diseases that ravage staple food crops and plantation and horticultural crops in PNG are of biosecurity concern to Australia. ACIAR has a cluster of projects that investigate better ways to manage these pests and diseases using systematic and environmentally sound methods. These include integrated pest/disease management techniques and biological-control options, some of which are focused on pest/disease surveillance, quarantine risk and incursion management. The projects aim to reduce crop losses and increase quality and productivity, providing better incomes for farmers. A new initiative will investigate the problems posed by invasive fish species as well as examine opportunities to better utilise existing populations of introduced exotic species.

The forestry work focuses on improved management of secondary forests via ongoing sustainable production and improved environmental services. All projects have capacity-enhancement components.

<i>Project number</i>	<i>Project title</i>
AH/2006/157	Animal health surveillance systems for Papua New Guinea
ASEM/2004/047	Sustainable management of coffee green scales in Papua New Guinea
ASEM/2006/129	Early warning and drought preparedness for improved management of crop production in Papua New Guinea
FIS/2005/096	Assessment of the impact of the Papua New Guinea purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices
FST/2004/061	Assessment, management and marketing of goods and services from cut-over native forests in Papua New Guinea
HORT/2005/136 (multilateral)	Mitigating the threat of banana fusarium wilt: understanding the agroecological distribution of pathogenic forms and developing disease-management strategies (Bioversity)
PC/2003/029	Management of potato late blight in Papua New Guinea (see Subprogram 2 for summary)
PC/2003/042	Fruit fly management in Papua New Guinea
PC/2004/064	Biological control of 'mile-a-minute' (<i>Mikania micrantha</i>) in Papua New Guinea and Fiji
PC/2006/063	Integrated pest management for Finschhafen disorder of oil palm in Papua New Guinea

PC/2006/114 (multilateral)	Managing cocoa pod borer in Papua New Guinea through improved risk incursion management capabilities, integrated pest management strategies and stakeholder participatory training (CABI)
PC/2007/111 (multilateral)	Incursion prevention and management of coffee berry borer in Papua New Guinea and Indonesia (South Sulawesi and Papua) (CABI)

AH/2006/157: Animal health surveillance systems for Papua New Guinea

Papua New Guinea, like many Pacific island countries and territories, is experiencing shortfalls in available veterinary and animal-health auxiliary personnel. This project will facilitate the collection and reporting of signs of disease in the country's livestock by introducing simple checklists and training to livestock owners and animal-health auxiliary staff in provincial departments, commercial livestock companies and NGOs. The capacity for such reporting will expand the reach of existing government animal-health staff. This in turn will assist with documentation and assessment of Papua New Guinea's animal-health status for endemic animal diseases, and facilitate more rapid reporting of incursions of exotic diseases and outbreaks of newly emerging diseases (which may be zoonoses—affecting both animals and humans). The improved information on disease distribution, prevalence and incidence will also greatly assist in disease-control programs.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Queensland Department of Primary Industries and Fisheries, Tropical Biosecurity, Australia

Project leader

Mr Robert Hedlefs
Phone: 07 4722 2696
Fax: 07 4778 4796
Email: robert.hedlefs@dpi.qld.gov.au

Collaborating Institutions

Department of Agriculture and Livestock, Papua New Guinea
Lutheran Development Service, Papua New Guinea
Murdoch University, Australia
National Agriculture Quarantine and Inspection Authority, Papua New Guinea
University of Goroka, Papua New Guinea
University of Technology, Papua New Guinea

Project budget

\$599,037

Project duration

01/05/2008 to 30/04/2012

ACIAR Research Program Manager

Dr Doug Gray

Website

<www.aciar.gov.au/project/AH/2006/157>

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

Coffee is the largest earner of foreign exchange with PNG. It is largely produced by smallholders in the highlands. Productivity of coffee has been hindered by inadequate pest management, and deficiencies in quality management and marketing. The main pest to coffee in PNG is coffee green scale, which on average reduces high-yield crops by 10%. This project will develop and foster uptake of biological control over other integrated strategies for coffee green scales. The project will document baseline information on the distribution, impacts, biology and control of coffee green scales in the coffee-growing zones in PNG. It will evaluate biological and other methods of controlling coffee green scales, taking into account grower information, and develop regional and national strategies for wider evaluation and implementation of coffee green scale control.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

CAB International, United Kingdom

Project leader

Sean Murphy
Phone: 44 491 829 129
Fax: 44 491 829 123
Email: s.murphy@cabi.org

Collaborating institutions

PNG Coffee Industry Corporation, Research and Growers' Services Division, Papua New Guinea
University of New South Wales, School of Biological, Earth and Environmental Sciences, Australia
PNG Coffee Industry Corporation, Papua New Guinea
University of New South Wales, Australia

Project budget

\$621,960

Project duration

01/04/2006 to 31/03/2009
(Project extended from 01/04/2009 to 31/10/2009)

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2004/047>

ASEM/2006/129: Early warning and drought preparedness for improved management of crop production in Papua New Guinea

Many Pacific island countries including PNG rely on subsistence farming and as such are vulnerable to the impacts of climate variability and climate extremes (floods and droughts). The ability of PNG to respond to these challenges will be largely influenced by its preparedness at local, institutional and national levels. An early-warning system based on seasonal climate forecasts and building local capacity in use of this technology is seen as a major step towards meeting these challenges. The highly variable climate also impacts greatly on the country's economy. In PNG, coffee production can generate almost 30% of the overall revenue for the country, and is the major cash-earning crop for the majority of people living in the rural areas. Statistics have shown that coffee production experiences significant fluctuations, mainly due to either too dry or too wet conditions which are associated with the El Niño and La Niña phenomena. Understanding the impacts of climate on PNG's agriculture and the ability to predict these events with sufficient lead time for government and farmers to take remedial action and adapt to a changing climate is crucial to the long-term sustainability of PNG's agriculture and the wellbeing of its people.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Queensland Environmental Protection Agency, Climate Change Centre of Excellence, Australia

Project leader

Mr David Cobon
Phone: 61 7 4688 1151
Fax: 61 7 4688 1490
Email: david.cobon@climatechange.qld.gov.au

Collaborating institutions

Bureau of Meteorology, Australia
National Agricultural Research Institute, Papua New Guinea
PNG National Weather Service, Papua New Guinea

Project budget

\$154,710

Project duration

01/04/2008 to 30/06/2010

ACIAR Research Program Manager

Dr Caroline Lemerle

Website

<www.aciar.gov.au/project/ASEM/2006/129>

FIS/2005/096: Assessment of the impact of the Papua New Guinea purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices

The tuna fishery in PNG—the largest in the Pacific islands region, is based on total allowable catches allocated by species type (skipjack, yellowfin and bigeye tuna) and gear type (purse seine and longline). Overfishing of tuna stocks due in part by the use of anchored fish aggregation devices (FADs) may have a negative impact on the sustainability of the tuna fishery in the region. The objective of this project is to manage the sustainability of the tuna fishery by providing information on tuna population dynamics and fishery impacts for the use of FADs. The project will provide information on the impacts of fishing in the PNG exclusive economic zone that will constitute the basis for appropriate management actions by the PNG National Fisheries Authority and contribute to regional stock assessment and fishery management.

Overseas collaborating countries

Papua New Guinea

Commissioned organisation

Secretariat of the Pacific Community, Oceanic Fisheries Programme, New Caledonia

Project leader

Dr John Hampton
Phone: 687 260 147
Fax: 687 263 818
Email: johnh@spc.int

Collaborating institutions

National Fisheries Authority, Papua New Guinea
University of Hawaii, United States of America

Project budget

\$400,000

Project duration

01/05/2006 to 31/12/2009

ACIAR Research Program Manager

Dr Chris Barlow

Website

<www.aciar.gov.au/project/FIS/2005/096>

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

Forest resources are a major contributor to different sectors of the PNG economy. The log export industry alone contributed some K200 million to the national economy in 2003, but its current level of harvesting is unsustainable and accessible primary forest is likely to be logged out in the next 15 years. Properly managed, however, PNG's forest resources could continue to make a major, sustainable contribution to the PNG economy, while maintaining many of the qualities that PNG society values from its forests. ACIAR's forestry strategy for PNG, developed in collaboration with PNG colleagues, is designed to promote a positive vision for PNG forestry. This project—a key element of the strategy—aims to improve the contribution that PNG's secondary forests make to national and local economies by developing appropriate strategies for their management and marketing. Project outputs will complement broader work on the marketing of PNG timber, under consideration by the International Tropical Timber Organisation and others.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Melbourne, School of Forest and Ecosystem Science, Australia

Project leader

Professor Rod Keenan
Phone: 03 5321 4124
Fax: 03 5321 4166
Email: rkeenan@unimelb.edu.au

Collaborating institutions

Australian National University, Australia
Papua New Guinea Forest Research Institute, Papua New Guinea
Village Development Trust, Papua New Guinea

Project budget

\$783,318

Project duration

01/05/2007 to 30/04/2010

ACIAR Research Program Manager

Dr Russell Haines

Website

<www.aciar.gov.au/project/FST/2004/061>

HORT/2005/136: Mitigating the threat of banana fusarium wilt: understanding the agroecological distribution of pathogenic forms and developing disease-management strategies

Banana is widely grown in tropical regions throughout Asia and northern Australia. Fusarium wilt disease of banana is, however, a major production constraint, capable of devastating a variety of banana cultivars. The disease is caused by *Fusarium oxysporum* f. sp. *Cubense*, with several 'races' infecting plants; some being more virulent than others. Fusarium spreads by lying dormant in soil for long periods. It cannot be controlled by fungicides, only through effective containment and management strategies. Successful strategies must be based on correct characterisation of fusarium pathogenic forms, with the means to do so being undertaken through this research to help develop national management strategies.

Overseas collaborating countries

Indonesia, Papua New Guinea

Commissioned organisation

Bioversity International, Philippines

Project leader

Dr Agustin Molina
Phone: 63 49 2580 5600
Fax: 63 49 536 7995
Email: a.molina@cgiar.org

Collaborating institutions

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

Project budget

\$600,566

Project duration

01/06/2006 to 31/12/2009
(Project extended from 01/06/2009 to 31/12/2009)

ACIAR Research Program Manager

Mr Les Baxter

Website

<www.aciar.gov.au/project/HORT/2005/136>

PC/2003/042: Fruit fly management in Papua New Guinea

Horticultural crops are a potential cash source for smallholders throughout PNG, often being grown on small, mixed-cropping farms. Fruit flies cause substantial losses for banana, papaya, mango, tomato, capsicum and cucurbits. The flies lay eggs in fruit, which then infest the fruit, rendering it inedible. Estimates put infestation levels in PNG routinely above 20%. Two species of fruit fly, *Bactrocera frauenfeldi* and *B. musae* are the leading pests and have been the subject of past research, which will be synthesised, tested, expanded upon where needed, and then disseminated to farmers through this project.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

NSW Department of Industry and Investment, Australia

Project leader

Dr Katina Lindhout
Phone: 61 2 4348 1965
Fax: 61 2 4348 1910
Email: katina.lindhout@industry.nsw.gov.au

Collaborating institutions

Fresh Produce Development Agency, Papua New Guinea
National Agriculture Quarantine and Inspection Authority, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea
Pacific Adventist University, Papua New Guinea
Queensland University of Technology, Australia
University of Western Sydney, Australia

Project budget

\$740,007

Project duration

01/04/2006 to 31/03/2010
(Project extended from 01/04/2009 to 31/03/2010)

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2003/042>

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

Food production, both of estate crops (sugarcane, vanilla, cocoa, coconut, banana, coffee, kava and palm oil) and in food gardens (taro, papaya and green vegetables) is important for smallholder incomes. This is particularly the case in Papua New Guinea, Fiji and Samoa. Two species of weeds, 'mile-a-minute' and 'giant sensitive plant' threaten these enterprises. Both are invasive weeds, widespread through each country, and capable of smothering food crops. Yields can be significantly reduced, affecting food security. Manual and chemical controls are too expensive for most farmers. Biological control, established through the identification and release of natural weed predators will be evaluated, based on known agents trialled or in use elsewhere.

Overseas collaborating countries

Fiji, Papua New Guinea

Commissioned organisation

Department of Employment, Economic Development and Innovation, Australia

Project leader

Dr Michael Day
Phone: 07 3405 5530
Fax: 07 3405 5551
Email: Michael.Day@deedi.qld.gov.au

Project website

<<http://www.spc.int./lrd/mikania>>

Collaborating institutions

Ministry of Agriculture, Sugar and Land Resettlement, Fiji
National Agricultural Research Institute, Papua New Guinea
Oil Palm Research Association, Papua New Guinea
Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea
Secretariat of the Pacific Community, Fiji

Project budget

\$579,018

Project duration

01/01/2006 to 31/12/2008
(Project extended from 01/01/2009 to 30/06/2009)

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2004/064>

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

Finschhafen disorder (FD), which leads to severe damage of palm fronds, was first observed in 1960 on coconut palms near Finschhafen in Morobe province, PNG. FD now threatens the production of oil palm. Limited research to date suggests the disorder may be a direct consequence of feeding by a planthopper (*Zophiuma lobulata*). This project will provide a foundation of biological knowledge to establish the causes of FD (it may be a micro-organism carried by the planthopper) and formulate appropriate responses. New information on the exact cause and viable control methods for FD will minimise the risk of further crop losses.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Charles Sturt University, School of Rural Management, Australia

Project leader

Dr Geoff Gurr
Phone: 02 6365 7551
Fax: 02 6365 7590
Email: ggurr@csu.edu.au

Collaborating institutions

NSW Department of Primary Industries, Orange Agricultural Institute, Australia
PNG Oil Palm Research Association Inc, Dami Research Station, Papua New Guinea

Project budget

\$399,950

Project duration

01/03/2007 to 28/02/2010

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2006/063>

PC/2006/114: Managing cocoa pod borer in Papua New Guinea through improved risk incursion management capabilities, integrated pest management strategies and stakeholder participatory training

Smallholder livelihoods derived from cocoa in PNG are threatened by the incursion of the cocoa pod borer *Conopomorpha cramerella* into the country. The pest was first detected in the Kerevat area of East New Britain province in March 2006 and later confirmed in Aitape of West Sepik province in June. Eradication operations, implemented in East New Britain after the first detection, were not fully implemented at West Sepik, and cocoa pod borer re-emerged in the Vudal, Tais and Tokiala smallholder blocks in the Gazelle Peninsula in March 2007. This project will assist PNG to effectively implement systematic and long-term pod-borer management through enhancing stakeholder knowledge and awareness, strengthening surveillance and monitoring efforts, developing pragmatic resource-matched and location-specific integrated pest management (IPM) programs, and developing farmer participatory training and research.

Overseas collaborating countries

Papua New Guinea

Commissioned organisation

CAB International, Southeast and East Asia, Malaysia

Project leader

Dr Wai Hong Loke
Phone: 60 3 89432921
Fax: 60 3 89426490
Email: loke@cabi.org

Collaborating institutions

Cocoa and Coconut Institute of PNG, Papua New Guinea
National Agriculture Quarantine and Inspection Authority, Papua New Guinea
University of Sydney, Australia

Project budget

\$704,300

Project duration

01/01/2008 to 30/06/2011

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2006/114>

PC/2007/111: Incursion prevention and management of coffee berry borer in Papua New Guinea and Indonesia (South Sulawesi and Papua)

Coffee production in PNG and Indonesia is threatened by the most serious pest, *Hypothenemus hampei*, known as coffee berry borer (CBB). In Indonesia, where 96% of coffee is planted by smallholders, CBB has infested 920,000 hectares and has led to an annual production loss of 15–20%. PNG production is under threat of incursion from the Papua province of Indonesia because the pest is present in Wamena and Oksibil districts—200 and 50 km from the PNG border, respectively. This project aims to prepare stakeholders in Sulawesi, Papua and PNG to manage and prevent incursion of CBB and thus ensure continued productivity of coffee plantings. This will come from enhanced stakeholder knowledge/awareness of CBB, strengthening surveillance/monitoring efforts for CBB management and incursion detection, and building up the capacity and institutional framework for CBB biosecurity management. Coffee is the major agricultural export commodity for PNG and a major source of cash to smallholders, thus any success in delaying the invasion of new zones by CBB will have a great economic impact.

Overseas collaborating countries

Indonesia, Papua New Guinea

Commissioned organisation

CAB International Southeast and East Asia, Malaysia

Project leader

Dr Soetikno S Sastroutomo
Phone: 60 3 8943 2921/3642
Fax: 60 3 8942 6490
Email: s.soetikno@cabi.org

Collaborating institutions

Indonesian Coffee and Cocoa Research Institute, Indonesia
Ministry of Agriculture Indonesia, Indonesia
National Agriculture Quarantine and Inspection Authority, Papua New Guinea
Papua New Guinea Coffee Industry Corporation, Papua New Guinea
Provincial Agricultural Services (Estates) Papua, Papua New Guinea
Provincial Agricultural Services (Estates) Sulawesi Selatan, Indonesia

Project budget

\$1,014,060

Project duration

01/06/2008 to 31/05/2013

ACIAR Research Program Manager

Dr Richard Markham

Website

<www.aciar.gov.au/project/PC/2007/111>

4 Projects expected to start in 2009–10

<i>Project Id</i>	<i>Title</i>	<i>Countries</i>
ASEM/2008/036	Improving livelihoods of smallholder families through increased productivity of coffee-based farming systems in the highlands of Papua New Guinea	Papua New Guinea
ASEM/2009/042	Researching women in agribusiness in Papua New Guinea	Papua New Guinea
FIS/2008/023	Increasing fish production from inland farming systems in Papua New Guinea for food and income security	Papua New Guinea
FIS/2009/014	Preliminary assessment of invasive and exotic fish species in Papua New Guinea	Papua New Guinea
FST/2007/078	Development of a Papua New Guinea timber industry based on community-based planted forests: design and implementation of a national germplasm delivery system	Papua New Guinea
FST/2008/050	Assembly of teak germplasm for provision to relevant ACIAR partner countries	Indonesia Lao PDR Papua New Guinea Solomon Islands
LWR/2009/040	Climate change meta analysis	Bangladesh Cambodia China East Timor India Indonesia Lao PDR Pakistan Papua New Guinea Philippines Vietnam
SMCN/2008/008	Sustainable vegetable production in Central province, Papua New Guinea	Papua New Guinea
SMCN/2009/013	Sustainable management of soil and water resources for oil palm production systems in Papua New Guinea	Papua New Guinea

5 Papua New Guinea chapter from the Annual Report 2008–09

5.1 Position

Papua New Guinea is one of Australia's most important development partners. Village-based agriculture supports more than 70% of the population, contributing both to food security and significant export crops. ACIAR's program in PNG supports the goals of the AusAID program, focusing on sustainable broad-based economic growth. With more than 85% of the population living in rural areas, developing agricultural industries and smallholder cash crops is critical to achieving this goal. Both ACIAR and AusAID work with PNG Government agencies to build sustainable institutions, with ACIAR focusing on building capacity in agricultural research, including through support for training and fellowships.

The ACIAR program aims to achieve practical impacts for PNG smallholders, consumers, industry and government through applied technical, social, economic and policy research. This is delivered through five subprograms: focusing on policy constraints to adoption of agricultural technologies; enhancing smallholder incomes from horticulture and root crops; improving smallholder returns from export tree crop production; developing new smallholder fisheries, aquaculture and forestry livelihoods; and biosecurity and sustainable resource management. Projects are clustered together, where possible, to address problems faced by major staple food and high-value commodities, such as sweetpotato, coffee, oil palm and cocoa.

5.2 Achievements

Subprogram 1: Addressing social, cultural and policy constraints to the adoption of agricultural technologies

Subsistence farmers in PNG and the Pacific islands are vulnerable to the impacts of climate variability and climate extremes (floods and droughts). The ability of PNG to respond to these challenges will be influenced by local, institutional and national organisations having an early-warning system based on seasonal climate forecasts. Building local capacity in use of this technology is seen as a major step towards meeting the challenges of climate variability. For example, coffee production can fluctuate widely due to drier or wetter conditions associated with the El Niño and La Niña phenomena. Understanding the impacts of climate on PNG's agriculture, and the ability to predict these events with sufficient lead time for government and farmers to take remedial action and adapt to a changing climate, is the subject of a project retrieving long-term rainfall data for PNG. This information is being used to determine the relationship between rainfall data and the El Niño Southern Oscillation (ENSO). A key component of the research involves investigating the utility of drought-warning tools to help maintain food security (sweetpotato) and farm income (coffee). Good-quality monthly rainfall data were assessed for 10 stations with a length of record between 52 and 106 years. These data were used in SCOPIC (for seasonal climate outlook for Pacific island countries) software for analysis of drought and to determine seasonal climate forecasts based on key ENSO indices.

Government policies, and the quality and reach of institutions (especially those that underpin market transactions and property rights) play a key role in shaping the incentives for primary producers to adopt outputs of technical research. While ACIAR has previously included studies on policy issues in its portfolio, it is now embarking on a more concerted effort to look at the effect of policy on the probability of its projects

having favourable impacts. A project is identifying strategies to help PNG deal with situations where the policy and institutional environment hinders the adoption of new technologies, or diminishes the benefits of adoption. The project team has developed its information base by researching the past portfolio of ACIAR projects in PNG, referring to adoption studies, impact assessments, working papers, project annual and final reports as far back as the late 1980s. This detailed information set is helping to identify and assess a range of relevant policy, institutional and economic factors that may affect project impact. A deeper assessment has begun, through examination of a smaller set of projects, of how economic, policy and institutional factors affect adoption and impact.

PNG has substantial stocks of tuna within its exclusive economic zone, some of which have been exploited by foreign fishing vessels paying access fees in exchange for fishing rights. PNG has adopted a policy of domestication of its tuna fishery, which involves encouraging domestic longline vessels and expanding the proportion of the purse seine catch taken by locally based vessels supplying domestic canneries. Further development of the tuna fishery will take the form of a change in the balance between the longline and purse seine fisheries, or a change in the allocation of the purse seine catch. As locally based purse seiners displace the purse seine fleets of distant-water fishing nations, access fees paid by the latter will decline. Domestic fishing must generate, at least, corresponding benefits for the host nation. A possible income source exists through foreign companies that have expressed interest in setting up tuna-processing operations in PNG.

Staff members of the National Fisheries Authority need help in developing and applying a method to analyse the economic benefits and costs to PNG of competing cannery proposals; a situation common to a number of countries in the Pacific islands region. The project developed a benefit–cost model for application to proposals for domestic development of the tuna industry, quantifying the range of benefits and costs to the host country from a domestic tuna cannery. Since the model also measures the net benefit to a foreign firm proposing investing in a cannery, under a range of possible financial arrangements, it can be used as a tool in negotiating any tax or similar concessions requested by the firm. PNG staff had full involvement in both the survey work at the cannery and development of the model, equipping them with the skills to apply the model to new proposals.

Subprogram 2: Enhancement of smallholder incomes from horticulture and root crops

Sweetpotato is an important food staple in PNG, with a suite of projects underway to lift productivity. A project to improve marketing efficiency, postharvest management and value-addition of sweetpotato began by mapping the social, economic and physical components of sweetpotato supply chains. The project's economic and technical teams worked together to develop an interdisciplinary approach to supply-chain analysis. On the economic side, the project team conducted interviews with the various participants in the supply chain from the highlands to coastal markets. On the physical side, the team carried out consignment trials across three different supply chains to determine where major losses were occurring and where intervention was warranted. On the social side, focus groups for women were conducted in Western Highlands and Eastern Highlands provinces, discussing gender division of labour, income distribution and problems encountered by women farmers in relation to sweetpotato marketing.

The potential for improving productivity of sweetpotato-based systems by addressing soil fertility as a major factor in yield decline has been demonstrated in an earlier study. Follow-on research is assessing and quantifying soil and water processes in highland soils, working with farmers to develop and implement improved nutrient and water management options for sweetpotato-based cropping systems (with a focus on existing indigenous soil-management systems), and enhancing PNG's soil research capacity.

One facet of the research has been a comparative nutrient analysis of different kinds of sweetpotato grown in the local village gardens. Growth trials took place at field sites in Eastern Highlands, Simbu and Western Highlands provinces. The treatments applied investigated a range of tillage methods (large mounds, small mounds and beds), coupled with mulch application and composting using different plant material, both burnt and unburnt. Useful information on tuber yields and quality parameters affected by the various treatments are being investigated to find promising technologies to increase productivity and quality of sweetpotato.

The decline in sweetpotato yields is also due to a combination of pests, diseases and physiological factors. A project to introduce an integrated pest management (IPM) approach is helping to reduce pest and disease losses. During the past year, the project has made some significant achievements. Prior to its commencement there was little scientific evidence to support the assumption that the sweetpotato yield decline phenomenon could be caused by viruses and virus complexes. The project has now identified four yield-limiting viruses in PNG. Investigations are also underway to determine if there may be virus interactions causing further yield reductions. Skills in virus indexing combined with serological virus testing have developed considerably in both PNG and Australia. PNG successfully tested 24 varieties for virus using *Ipomoea setosa* grafting and confirmation by enzyme-linked immunosorbent assay (ELISA) testing. This improvement in diagnostic capability in both PNG and Australia will improve the soundness of disease identifications and better assist in inter-country germplasm exchange.

Subprogram 3: Improving smallholder returns from export tree crop production and marketing

Changes in coffee production have created a widely held perception that the quality of PNG coffee has fallen and, as a result, the price of PNG coffee has declined relative to the world price. A suite of projects is working to address several significant issues, including a shift from larger estate production to smallholder production. A project has focused on identifying smallholder strategies to improve coffee quality at the community level. Three possible strategies to improve the quality of coffee produced by smallholders have been investigated: encouraging the sale of red ripe cherry direct to the wet mills; adopting standardised processing systems at the village level; and pursuing Fairtrade, Rainforest Alliance, Organic and/or Utz Certified accreditation. Of these strategies, the sale of cherry results not only in a 34% price premium but entails significantly less work and costs for the growers. Where smallholder coffee farmers are unable to sell cherry to wet mills, standardised processing systems must be introduced at the village level. In this instance, price incentives would be best achieved through the formation of collaborative marketing groups that transact directly with traders and exporters. This would also be the best arrangement for pursuing accreditation under the fair trade and organic markets.

In July 2008, the Coffee Industry Corporation reported an oribius weevil epidemic on coffee in Simbu province. Should such an epidemic spread to other districts and provinces, it has the potential to severely impact the PNG coffee industry. Research to stem the weevil's migration and find ways to combat the pest is underway. The project team found low levels of the weevil and damage from sucking bugs. It suggested that the 'outbreak' was likely to have been a combination of greater identification stemming from enhanced public awareness, resulting in greater recognition, and generally elevated pest populations due to atypical climatic patterns (especially a wetter 'dry' season). Permanent, structured monitoring to track pest populations and damage levels on coffee in Simbu and neighbouring provinces for the 2008–09 coffee seasons was recommended. If damaging pest levels do not occur in 2009, no further action beyond low-level permanent surveillance would be needed.

The incidence of coffee green scales (CGS), which can cause up to 10% loss in coffee yields, was determined via major surveys in Eastern Highlands province in 2006–07. Subsequent analysis of this study showed that CGS infestations were highest at 1,500 metre altitude—both above and below this, infestations were much lower. Both human-mediated and natural pathways appear to be involved in CGS spread. Nurseries grow and supply seedlings that happen to be infested with CGS, and simple sanitation could make clean plants available to farmers. However, another common route is via infested farms where farmers propagate their own seedlings. With the natural spread possibly being mediated via exotic invasive ants, both ecological and anthropogenic issues need to be resolved, and a scoping study has addressed farmer practices, awareness and extension. An additional study determined that excluding ants reduces CGS infestation rates over time.

A project is seeking to improve extension delivery through greater commercial-sector engagement with smallholders, and to develop effective land-use agreements between the commercial sector and customary landowners. A core component of the project is to implement innovative payment systems for productivity-enhancing inputs that accommodate the sociocultural context of smallholder production. For example, work at Bialla with oil palm has introduced a mobile card payment scheme that guarantees payment of family and hired labour for work on smallholder oil palm blocks. The payment initiative was developed and trialled successfully in an earlier ACIAR project. In addition, a draft Clan Land Usage Agreement has been developed after extensive consultation with the Oil Palm Industry Corporation, customary landowners and migrant smallholders growing oil palm on customary land in Bialla, Hoskins and Popondetta.

Symptoms of magnesium (Mg) deficiency are widespread on volcanic ash soils where oil palm is grown in West New Britain. However, application of soluble Mg fertilisers such as kieserite had failed to significantly increase yields. Field trials were conducted to gain a better understanding of this problem. The effectiveness of Mg fertilisers with different solubility and application methods were tested. As potassium (K) is known to compete with Mg uptake, the project was broadened to include research on K. Valuable information has been obtained from this research on Mg and K dynamics in soil, spatial distribution of root activity and uptake of these nutrients under different soils. This information has been used by the plantation companies to reassess fertiliser recommendations to overcome nutrient deficiencies and increase the productivity of oil palm.

Subprogram 4: New livelihoods from smallholder fisheries, aquaculture and forestry

Efforts are underway to improve fingerling supply and fish nutrition for smallholder farms adopting inland aquaculture in PNG. A total of 1,460 smallholder farmers have received training in various aspects of pond culture of the commonly used tilapia and carp. A number of small feed mills have been installed and are operating in the Eastern Highlands and Morobe provinces. There is good potential to use these mini mills for poultry feeds as well as fish feeds. A rehabilitation program based on fish farming has been initiated for prisoners at Bihute Prison. The program was well regarded and there is acknowledged potential for the scheme to be used as a model for the PNG prison system.

Everywhere in PNG, tree growing and management of trees are incorporated into both traditional and modern farming systems. Commercial tree growing appears a good prospect for landowners with limited income-generation alternatives. A project is working to encourage the adoption of commercial-scale high-value tree growing in PNG, developed through a relationship fostered between landowners and selected business partners. Fieldwork in three project pilot-study regions has found that the land-use systems, and landowner experience of commercial tree growing, vary significantly between the three regions. Some landowners in the North Coast and

Golgol Valley regions around Madang have participated in growing *Acacia mangium* for export; a smaller number in the Markham and Ramu valleys are at an earlier stage of growing trees with commercial potential; in Western province, the only landowners that have engaged in commercial tree growing are those participating in rubber cultivation in various forms of partnership facilitated by North Fly Rubber Ltd. Preliminary results from Western province fieldwork have assisted the project team to develop a draft assessment of possible commercial tree-growing activities and associated business models.

Past ACIAR research established the feasibility of domesticating and commercialising the canarium nut in PNG. The nut is currently used for food but supply falls well below demand. A new project is now building on those findings, seeking to ensure sufficient supply of *Canarium indicum* and establish a reliable marketing network. The project is working to select cultivars that produce nuts regularly and fruit heavily to close the demand gap. Robust nursery propagation techniques using low-cost systems suitable for community and village uptake are being established to help create a more regular supply of high-quality fresh nuts as a basis for development of a marketing network.

The project has made substantial progress in both vegetative propagation and genetic resource exploration/characterisation. A breakthrough was achieved in vegetative propagation of juvenile material, with success rates now above 90% for the best treatment combinations. Success is attributed largely to use of higher-quality stock plants, and research on stock-plant management is continuing. Marcotting (air-layering) of superior adult canarium trees is being used as a way to capture their genotypes for future multiplication. Although canarium is difficult to marcot, success rates have been sufficiently high to permit capture of the genotypes of superior adult trees. Another project is developing protocols for the processing and storage of canarium nuts. The project participants, with experience in the macadamia industry, have already developed a modified macadamia nut cracker that is effective for canarium and is attracting interest within the PNG industry.

Fuelwood is a crucial but undeveloped component of the domestic economy of PNG. Fuelwood plantations could directly enhance smallholder income and provide a pathway for rehabilitating grasslands. A project is establishing a national fuelwood economy based on woodlots and agroforestry systems. Project activities in 2008–09 focused principally on fieldwork in the three project pilot-study regions in Morobe, Madang and Western provinces to investigate landowner attitudes to tree growing as part of their farming systems. Development of village-level nursery systems and the delivery to landowners of seedlings of commercial species raised in other nurseries is underway with landowners in the Markham and Ramu valleys.

PNG enjoys some significant competitive advantages in relation to the production of timber; however, a challenge remains in the management of secondary forests. Smallholder agroforestry plantings and community-based management offer significant potential to address this challenge. This industry could become a much larger contributor to the national economy than the current log export industry if coupled with a significant domestic-processing industry. A project is providing the foundation for a more extensive and more sophisticated domestic timber-processing industry in PNG. It is exploring the development of various products and designs based on solid wood and veneers, examining the potential for value chains to integrate advanced processing with production of timber in smallholder agroforestry systems and community-managed secondary forests, and enhancing capacity in timber-processing training, education and R&D.

Subprogram 5: Agricultural biosecurity and sustainable management of forestry and fisheries resources

There is an ongoing problem of poor reporting of animal diseases in PNG, where veterinary or allied animal-health resources are limited, livestock production is often at smallholder or subsistence levels, and infrastructure is limited. A project is developing systems that are sustainable, are simple to operate, provide a basic set of animal population data, and are capable of estimating the impacts of disease on the production system. Templates of two reporting tools were developed for pigs and chickens, which are the most prolific livestock kept in the project sites and underpin the village livestock food and income streams. These templates, developed and revised after initial use at the project sites, enable village livestock owners to record information on chicken and pig populations, reproductive rates and end uses of the livestock, including sale at market or family food production. The templates also record syndromes of skin, intestinal, respiratory and nervous diseases.

A concern for crops in PNG is Ramu stunt disease of sugarcane, for which the island sugarcane planthopper *Eumetopina flavipes* is the only known vector. Fortunately, this disease does not occur in Australia, but virus-free populations of this planthopper occur in the Torres Strait Islands (TSI) and northern peninsula area (NPA) of Queensland. A research team has worked to develop an integrated management program for *E. flavipes* in commercial sugarcane plantations at Ramu Sugar Ltd (where Ramu stunt disease continues to impact upon production) and to gain a detailed understanding of the population ecology of *E. flavipes* populations throughout PNG and TSI/NPA. There are now recommendations on pre-emptive management of *E. flavipes* in TSI/NPA via cultivation techniques such as simultaneous tip pruning. However, in PNG, due to the widespread distribution and persistence of the pest across multiple wild and cultivated hosts, management effort should be more focused on dealing with Ramu stunt disease—via planting new, resistant varieties and vigilant surveillance for new disease outbreaks.

Cocoa pod borer (CPB) is having a devastating impact on the livelihoods of smallholder cocoa growers in East New Britain, with almost 90% of production lost in some areas. A project team undertook a social and economic impact assessment of CPB in May 2009 as part of developing a strategy to address the problem. Controlling CPB requires farmers to raise inputs of labour to undertake CPB management techniques such as weekly harvesting (every mature pod), centralised pod breaking and pod burial. High levels of block management (pruning, shade control and weed control) are also needed. This is the opposite of the usual low labour-input system of production (the foraging strategy) employed by PNG farmers. The project is working with commercial-sector partners to deliver new forms of extension designed to mobilise labour for effective control of CPB. Promising results from the monitoring program are emerging, with some farmers switching to a high-input system and effectively controlling CPB.

The log export industry in PNG contributed K476 million to the national economy in 2005, but its current level of harvesting is unsustainable. Accessible primary forest is likely to be logged out in the next 15 years. Properly managed, however, PNG's forest resources could continue to make a major, sustainable contribution to the PNG economy while maintaining many of the qualities that PNG society values from its forests. ACIAR's forestry strategy for PNG, developed in collaboration with PNG colleagues, is designed to promote a positive vision for PNG forestry. This project, a key element of the strategy, aims to improve the contribution that PNG's secondary forests make to both its national and local economies. Collated, checked and cleaned data have been collected from 120 permanent sample plots measured repeatedly between 1992 and 2008. The improved database is now complete and ready for analysis as part of the development of new growth models for cut-over forest in PNG.

Research continued in four provinces in PNG to investigate the efficacy of various fruit fly management strategies. These have been completed and the results are now being collated for analysis. The results of these trials will provide useful information regarding the effectiveness of management strategies such as protein baiting, male annihilation technique, fruit bagging and local pesticide use in each location and crop. An economic analysis based on a single farm case study is determining if the level of control achieved from the management strategies provides benefits that outweigh the cost of the technologies themselves. This will inform recommendations to further develop the supply chain for these technologies, which are currently not commercially available.

Other projects

The ACIAR postgraduate scholarship scheme for PNG University of Technology (Unitech) commenced in 2005 and is now into Stage 3 of support; currently, there are six ACIAR scholars undertaking Postgraduate Diploma (PGD) training in 2009, three ACIAR scholars have been accepted for MSc training in 2010 and three more scholars for PGD training in 2010. Students' research projects have been linked with active ACIAR projects in PNG.

The smallholder broiler chicken industry produces about six million birds per year with a value of A\$54 million. Reducing feed costs, the main constraint to profitability, is the subject of a project investigating 'best-bet' feeding options for feeding broiler chickens in highland and lowland regions of PNG. Evaluations of options were conducted at NGO demonstration sites using a concentrate system developed by the National Agricultural Research Institute (NARI). The diets found to be the most suitable for growing meat birds were: 50% sweetpotato + 50% low-energy concentrate; 70% sweetpotato + 30% low-energy concentrate; and 50% cassava + 50% high-energy concentrate. The three NGO partners compared the diets in broiler grow-out trials in the highlands, the lowlands and in remote Western province, obtaining such promising results that each has now selected 20 village farmers to test their respective best-performing concentrate feeding system against the current broiler feeding system that uses commercial feed. The project also established that there are good prospects for a mini mill to produce chicken feeds based on local ingredients.

An ACIAR project to improve yield and economic viability of peanut production in PNG and Australia has documented the critical role of peanuts in PNG farming systems. High-yielding peanut germplasm lines from the International Crop Research Institute for the Semi-Arid Tropics were introduced and evaluated in multi-location trials in PNG, leading to the identification of promising varieties with potential to yield 50–100% greater than the local varieties. These new varieties are being transferred, with associated management technologies, to smallholders. This is enhancing the markets for, and marketability of, new peanut varieties in PNG. The project also assisted farmers affected during the Oro province natural disaster, supplying 0.6 tonnes of seed for the restoration program.

Fourteen 'seed village' trials conducted in the Upper and Lower Markham Valley regions, Eastern Highlands province, showed that productivity of dryland peanut can be increased from the existing 1 tonne per hectare to 4 tonnes per hectare by using local or new varieties and adopting a set of improved practices. The research outcomes have led to publication of a best management practice manual for growing peanuts in PNG, published as ACIAR Monograph No. 134.

5.3 Pyrethrum—PNG's resurgent industry

When the pyrethrum daisy plant was introduced into PNG in the late 1950s, it formed a major highland industry—employing as many as 80,000 people by the late 1980s. It is the source of pyrethrum, an in-demand insecticide with benign properties that make it desirable for use in insect sprays, pet shampoos and home gardening products. The PNG growers sold their local product to a processing factory and the factory owners handled the marketing. Closure of this factory ended the local market and curtailed the industry.

Now a Tasmanian pesticide manufacturer has come to the aid of the women in PNG whose livelihoods were affected by the closure of the industry. Botanical Resources Australia (BRA) has offered to buy the PNG crop and help recommercialise the industry. Despite conducting research in Australia, BRA had little experience of research for development, and certainly not in PNG. ACIAR was well placed to bridge the gap—a project was developed and commenced in 2007. To date, BRA has helped improve the Enga province processing factory and refurbished its laboratory.

Better planting materials and improved agronomic practices, along with research into the adoption of improved production and plant physiological factors, are essential requisites for the project's success. Janet Yando, who has been appointed Extension and Promotion Officer for the project, speaks of her involvement:

'I mostly work with local farmers, particularly pyrethrum growers in several communities. My task is to encourage farmers, mostly women and youth groups, to increase production. I conduct informal training sessions on their farm sites to show them better ways of planting the crop, better management practices, and the right time to pick.

'But 45% of my time each week is spent at the resource centre, working on clonal selection plots, density trial plots and other tasks. I work with the agronomist from NARI to improve planting materials for the farmers. Then I pass on information on the results of our work to the farmers during the field visits.'

Meanwhile, BRA has hosted a visit of five key PNG officers to its Tasmanian factory. Mr Brian Chung, manager of product development at BRA, states that while the company's involvement in a development aid project was somewhat unexpected, BRA has now found its stride. 'It became obvious we had the skills and technology to make substantial improvements,' he says. 'So we intend to be in for the long run.'

6 Projects concluded in 2008–09

AH/2008/037: Potential economic impacts of the varroa bee mite on the pollination of major crops in Papua New Guinea

Honeybees (*Apis mellifera*) were introduced to PNG more than 50 years ago, where they have been managed for their honey and have spawned feral populations. Insect pollination increases the yield and the quality of many important crops, and bees are widely regarded as the most important pollinators. But in recent decades, the most potent threat to bee pollination has come from a deadly parasitic mite of bees, *Varroa destructor*. So far, PNG and Australia have been free of this mite disease, but in other countries such as the United States of America and New Zealand, it has caused significant economic impacts. In 2008, it was discovered that the endemic *Varroa* species in PNG (*V. jacobsoni*) has acquired traits that threaten to make it as deadly as *V. destructor* to the honey bees.

This project assessed how this significant development could affect crop production in PNG through the development of future scenarios for the impact of bee mites on pollination. Scientists estimated the potential economic losses and associated ranges for the crops of highest value within each scenario developed, and identified knowledge gaps regarding management of this threat to PNG agriculture as a guide for future research. They developed a bioeconomic model for PNG based on one already used by CSIRO, designed to assess the possible economic impact should varroa mite invade Australia. The outcomes are designed to improve decisions for PNG on the strategies needed to control the newly identified *V. jacobsoni*. This will benefit Australia because PNG is one of the main potential pathways for entry of this disease.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

CSIRO Entomology, Australia

Project leader

Dr Saul Cunningham
Phone: 02 6246 4356
Fax: 02 6246 4000
Email: saul.cunningham@csiro.au

Collaborating institutions

National Agricultural Research Institute, Papua New Guinea
Rural Industries Research and Development Corporation, Australia

Project budget

\$60,376

Project duration

01/11/2008 to 31/10/2009

ACIAR Research Program Manager

Dr Doug Gray

Project outcomes

The scientists conducted two workshops in PNG to collect and discuss information and formulate possible scenarios. This information was supplemented by the published scientific literature. They conducted economic modelling, using an existing model of varroa spread and impacts, but modified to the particular circumstances in PNG. They also made observations of insect visitors to flowering crops at lowland and highland locations to improve their knowledge regarding which bees are acting as potential pollinators.

The scientists concluded that in the most likely scenario the impacts of the new varroa would be limited to *A. mellifera* and therefore geographically limited to the highlands. Losses to agricultural production are expected to be low because dependence on *A. mellifera* for crop pollination is low. This is because the managed honey-bee population is small and rarely used for managed pollination. The feral honey-bee population may be large, but nevertheless there are many other wild and feral bee species that are likely to provide a similar crop-pollination service (most notably *A. cerana*) and therefore a decline in one species is unlikely to have significant repercussions. The impact on managed hives would cause damage to honey production and limit opportunities for future development of managed pollination.

This predicted impact was, however, contingent upon a number of assumptions made because of limited local information. Therefore, the scientists also estimated the possible impact if honey-bee decline were to lead to crop-pollination decline (a 'worst case' scenario). They concluded that the largest economic risk was associated with the cash crop, highland coffee. Assuming that the new varroa actually emerged 6 years previously, and assuming only honey bees were effective pollinators of highland coffee, then the predicted mean annual losses would be K14.2 million over the next 24 years.

To provide greater certainty around the likely economic impacts of the new mite, the scientists suggested gathering more data regarding the distribution and abundance of feral honey bees, and also the influence of variation in the pollinator community on fruit set by highland coffee in PNG. Further research on coffee pollination would also assist in coping with changes expected due to the mite, and could help coffee growers increase the fraction of their crop sold with a premium for large bean size.

ASEM/2003/015: Enhancing Papua New Guinea smallholder cocoa production through greater adoption of disease-control practices

Papua New Guinea's cocoa sector supplies 2% 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 (A\$87 million) per annum based on 42,000 tonnes production. Smallholders usually grow cocoa as a supplementary income source with few inputs and low costs reducing the impacts of market price fluctuations. One reason for the low inputs 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 and associated decline. One of the major causes was, and remains, disease. 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 aims of this project were to sustainably increase the profitability of smallholder cocoa production in PNG through the development of effective and affordable strategies in partnership with farmers, and to develop effective management options for the major disease threats to production, by:

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

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Sydney, Faculty of Agriculture, Food and Natural Resources, Australia

Project leader

Professor David Guest
Phone: 02 9351 2946
Fax: 02 9351 4172
Email: d.guest@usyd.edu.au

Collaborating institutions

MasterFoods Australia New Zealand, Australia
Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea
Papua New Guinea University of Technology, Papua New Guinea

Project budget

\$549,920

Project duration

01/01/2005 to 31/05/2009
(Project extended from 01/01/2008 to 31/05/2009)

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

Final report not yet submitted by the project leader

ASEM/2004/011: Evaluating domestic tuna fisheries projects

While PNG has substantial stocks of tuna within its exclusive economic zone, the annual sustainable catch from these resources has probably already been achieved. Further development of the tuna fishery will take the form of a change in the balance between the longline and purse seine fisheries, or a change in the allocation of the purse seine catch. PNG has adopted a policy of domestication of its tuna fishery, which involves encouraging domestic longline vessels and expanding the proportion of the purse seine catch taken by locally based vessels supplying domestic canneries. As locally based purse seiners displace the purse seine fleets of distant-water fishing nations, the level of access fees paid by the latter will decline. Lower access fees are a real cost to PNG and it is important to ensure that the domestic operations which replace those fleets generate at least corresponding benefits for the host nation.

Many foreign companies have expressed interest in setting up tuna-processing operations in PNG. At the time the project was conceived, two plants were in operation with several others proposed. Staff at the National Fisheries Authority needed help in developing and applying a method of analysing the economic benefits and costs to PNG of competing proposals. Other countries in the Pacific Islands region were facing similar issues and staff at the Forum Fisheries Agency (FFA) indicated that they would also like to be involved in the project.

The objective of the project was to develop a benefit–cost model that could be applied to proposals for domestic development of the tuna industry in order to calculate the full range of benefits and costs of any proposed development by a foreign firm. The methodology of a spreadsheet-based benefit–cost model had already been developed, and the aim of the project was to gather the data required to apply this model to the analysis of an established cannery in Madang, PNG, as a case study. The case study would then serve as a template for analysis of proposed processing projects in the region.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

University of Queensland, School of Economics, Australia

Project leader

Professor Harry Campbell
Phone: 07 3365 6570
Fax: 07 3365 7299
Email: h.campbell@economics.uq.edu.au

Collaborating institutions

National Fisheries Authority, Papua New Guinea
Forum Fisheries Agency, Solomon Islands

Project budget

\$331,435

Project duration

01/04/2005 to 31/12/2008
(Project extended from 01/04/2008 to 31/12/2008)

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

Estimates were generated of a range of shadow prices required to measure the opportunity cost to PNG of the resources, principally fish stocks and labour, it contributes to a domestic tuna-processing operation. A large sample survey of the domestic labour force in the Madang cannery was undertaken with the cooperation of the company and a great deal of data about employees' personal and employment characteristics was collected and analysed to determine the shadow price of labour. The data were also used to determine the effect of level of education on labour productivity in the cannery.

Shadow prices of tuna catches, foreign exchange, public funds, environmental costs and locally provided services were also considered. The results were incorporated in a spreadsheet benefit–cost analysis using the method earlier developed by Campbell and Brown, which emphasises the net benefits to the host country. A member of the FFA staff undertook a similar analysis of a proposed tuna cannery in Solomon Islands.

The benefit–cost model details and measures the range of benefits and costs which the host country could expect to flow from a domestic tuna cannery. Since the model also measures the net benefit to the foreign firm under a range of possible financial arrangements, it can be used as a tool in negotiating any tax or similar concessions requested by the firm. Since partner-country staff members were fully involved in the survey work at the cannery and the subsequent development of the model, they are able to apply their knowledge to new proposals as they come forward. Working on the project has also improved the general level of understanding about the range and size of the benefits and costs of domestication to the countries of the region. The model and its results are available to fishery analysts throughout the region at:
<<http://www.uq.edu.au/economics/tuna>>.

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

The PNG coffee industry supports 350,000–400,000 families and earns K300 million per annum, but the consistency and reliability of coffee quality has declined with the move to the low-input management of the smallholder industry (>85%, the remaining plantation and 'block' production has received higher prices). Despite this general decline, premium PNG coffee retains a good reputation amongst customers and there is good scope to build demand for PNG coffee by improving marketing and quality. PNG highlands coffee is of the arabica species, and the genotype x environment (G x E) potential is ideal for good-quality coffee. However, critical postharvest steps from harvest, through wet processing, drying, grading, storage and transport, affect coffee quality and grade/sales potential, while further steps (roasting, grinding etc.) affect end-market opportunities for the coffee quality/grade received by the roaster.

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

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

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

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

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of New South Wales, Department of Food Science and Technology, Australia

Project leader

Dr Robert Driscoll
Phone: 02 9385 4355
Email: r.driscoll@unsw.edu.au

Collaborating institutions

AT Projects, Papua New Guinea
PNG Coffee Industry Corporation, Papua New Guinea

Project budget

\$760,812

Project duration

01/01/2006 to 30/06/2009

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

The project members undertook a major assessment of postharvest-system constraints to smallholder management of coffee quality and product consistency. The implementation of the final socioeconomic survey component also provided an avenue for the dissemination of information on postharvest best practice. As a result of the survey, the project teams developed and tested solutions to system deficiencies, with particular attention to improvement of drying and storage. The team tested an eco-processor, which reduced water usage in coffee processing and combined three unit operations into one. Results of controlled trials at the Coffee Research Institute (CRI; part of CIC) have been positive. The testing of the eco-processor is still progressing. A second unit (with a petrol engine) has been imported and is currently being used in demonstration trials at village level. Training in their use is required to ensure selection of the correct unit for the coffee type, and adjustment of the equipment can then give a similar product to conventional processing. Sun-drying experiments were carried out using the traditional sun-drying system on various surfaces mounted on drying tables. Studies on major factors affecting sundrying have given surprising results. The major factors considered were drying surface, elevation, shading and stirring. The current method (using blue plastic tarpaulins) gives a result comparable with the optimum method.

Computer-simulation studies of solar drying revealed that this was not a suitable design for the culture and climatic conditions. Firstly, the growing climate is cold and wet; secondly, a high collection area is required; and thirdly, a high degree of maintenance would be required to keep the solar dryers operational. For these reasons, it was decided not to continue with studies on solar dryers. Drying studies continued throughout the project, and the third possibility for improving drying was a relatively new development—greenhouse dryers. These dryers differ from solar dryers in their use of heat recycling. Smallholders in coffee-growing areas of Colombia have adopted them, and early results indicate that this option can work with a fraction of the space required for a solar dryer. A new design of this type of dryer is currently being tested and will be compared to the traditional sun-drying system.

Work also measured chemical quality, including studies on best drying temperature, chemical changes during storage and chemical ratios during roasting. Coffee storage trials using dried green coffee beans (*Coffea arabica* cv. K7, origin northern NSW) and two storage temperatures (15 °C and 30 °C) with a reference sample kept in the freezer at –20°C were conducted in environmental chambers for 24 months at the University of NSW in Sydney. The results showed a positive effect of higher storage temperature on the aroma precursors in the beans. A major aspect of the project was

the construction and provision of a new laboratory at CRI, designed for measuring both physical (such as density) and heat (such as thermal conductivity) properties of coffee beans. This laboratory was used for the first time in the analysis of the sun-drying trials, then later used for measuring coffee properties.

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

Coffee growers in PNG fall into two broad sectors: the estate (comprising block holders and plantations) and the smallholder sector. Of the two, it is the smallholder sector that produces most of the country's coffee, accounting for 85% (56,100 tonnes) of production. The estate sector has been in decline over the past 2 decades and now produces only 9,900 tonnes. Coffee export is an important component of PNG's economy—10% of PNG export revenue is coffee, generating 5% of gross domestic product (GDP). Almost 400,000 rural households grow coffee and 20,000 people are employed in the processing and marketing areas. But quality of coffee parchment derived from the beans is a perpetual problem. And one of the major obstacles to the improvement of coffee quality is failure of the current marketing system to give the right price signals to growers, in terms of different prices for different qualities of coffee parchment.

Some smallholder producers are commanding price premiums through their involvement in collaborative marketing arrangements. They have established long-term working relationships with suppliers who pay premium prices in return for good-quality coffee. This is a departure from current practices of paying a single price regardless of quality; guaranteeing a return to smallholders but in turn sacrificing overall quality. The alternative arrangements where groups of growers are linked to processors suggest that tying price to quality can lift product quality if the working relationship provides sufficient market signals and information.

This project investigated the prevailing market structure, seeking to identify the factors that prevent market intermediaries from rewarding growers for quality, and to recommend a course of action to bring improvements to the market. The project aimed to improve the economic returns to PNG smallholder coffee producers and the industry, through delivering a more consistent and higher-quality product. The major objective was to better understand the factors influencing adoption and ongoing success of the collaborative collection, pricing and processing schemes, and to plot strategies for their successful expansion.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Curtin University of Technology, Agribusiness Marketing (Horticulture), Australia

Project leader

Dr Peter Batt
Phone: 08 9266 7596
Email: p.batt@curtin.edu.au

Collaborating institution

PNG Coffee Industry Corporation, Papua New Guinea

Project budget

\$541,502

Project duration

01/04/2005 to 30/09/2008

(Project extended from 01/04/2007 to 30/09/2008)

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

This project focused on identification of smallholder strategies for improving coffee quality at the community level. It did not address the three major overarching issues that currently constrain the potential quality of the coffee produced in PNG, namely: 1, the poor state of the roads and transport infrastructure; 2. lawlessness; and 3. the insecurity of land ownership and tenure. To improve the quality of the coffee produced by smallholder coffee growers, three broad strategies were available: 1. encourage the sale of red ripe cherry direct to the wet mills; 2. adopt standardised processing systems at the village level; 3. pursue accreditation under Fairtrade, Rainforest Alliance, Organic and/or Utz Certified.

It was evident that parchment was purchased at a significant discount to cherry, reflecting the lack of control and the variability that is inherent within smallholder parchment. On a per-kilogram parchment-equivalent basis, the sale of cherry results not only in a 34% price premium, but entails significantly less work and costs for the growers. There are savings in processing and transport costs, there is less likelihood of product deterioration through poor and inappropriate storage in the home (smoke damage and moisture) and less risk of theft. The researchers found that where smallholder coffee farmers could not sell cherry to wet mills, standardised processing systems were needed at the village level. However, price incentives would only be achieved where smallholders could achieve a parallel increase in scale. This was best achieved through the formation of collaborative marketing groups that transact directly with traders and exporters. The success of these collaborative marketing groups will demand that the groups have some sustainable competitive advantage, are well managed and appropriately led. Groups that are based around traditional family or 'haus' lines will have the greatest chance of being sustainable in the long term.

The research team reported that since much of PNG coffee is grown with minimal inputs and is very much in sympathy with the environment, there are opportunities for smallholders to pursue accreditation under Fairtrade and Organic. However, growers must be mobilised into collaborative marketing groups and linked directly to an exporter who is willing to assist. With PNG coffee growers receiving more than 70% of the free-on-board (FOB) (Lae) price, the team found little evidence to support the premise that smallholder coffee growers in PNG are subject to exploitation by downstream market intermediaries. Furthermore, the team found no evidence to suggest that grower direct marketing will provide higher returns to growers. Quite to the contrary, given the small volumes and the risks associated with managing exchange rates, the price differentials and the inherent risk that the product may fail to meet the customers' specifications, smallholder coffee growers do not have the expertise to perform these activities any more efficiently than the existing traders and exporters.

To improve the linkages between smallholder coffee growers and the exporters, the team recommended training in budgeting, agronomy and rehabilitation, processing and marketing. With a greater understanding of the market dynamics, risk management and the costs associated with export, relationships between smallholder growers and their respective exporters would improve. Structured tastings with growers would provide a means to demonstrate how the major faults associated with the production of parchment influence the taste. Another recommendation was the staging of workshops to assist grower groups in the maintenance of pulpers and the adoption of standardised processing systems. In the delivery of the training, the team advocated use of a participatory rural appraisal and planning process model with the inclusion of a personal viability training module to facilitate more enduring relationships within the community and to raise self-awareness.

ASEM/2004/077: Postgraduate scholarship scheme for Unitech, University of Technology, Lae, Papua New Guinea

In response to new initiatives by University of Technology (Unitech), Lae, in PNG to introduce a program of postgraduate training in 2005, ACIAR funded a scholarship program to support students during their training. It initially provided funding in 2005 for six students (stipend plus all costs associated with project administration and research support). The project intended to train a total of nine candidates to Postgraduate Diploma (PGD) level and six as Masters of Philosophy graduates. Unitech staff supervised these projects with planning assistance from University of Queensland staff. They were encouraged to seek research linkages with ACIAR, NARI and industry projects. Progress was reviewed annually and continuation recommended where each group of students graduated in the prescribed time.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Queensland, School of Land and Food, Australia

Project leader

Dr Barry W. Norton
Phone: 07 3289 0260
Email: b.norton@uq.edu.au

Collaborating institution

University of Technology, Head, Department of Agriculture, Papua New Guinea

Project budget

\$741,049

Project duration

01/01/2005 to 31/03/2009
(Project extended from 01/07/2008 to 31/03/2009)

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

This scheme has provided a stream of graduates who have been quickly taken up into government departments and research institutes, industry and universities, providing expertise urgently needed by the rapidly developing agricultural industries in PNG. The value of this joint initiative between the Department of Agriculture and ACIAR is recognised throughout PNG as a model for the future development of locally trained research expertise in PNG. Some recent graduates are now being offered positions in NARI, are becoming more involved in ACIAR projects, and have been successful applicants for postgraduate training in Australia. Australia is a world leader in many fields of agriculture, and this expertise is being shared with Unitech staff to help develop high-quality graduates who will be advanced in the application of the science of agriculture to this very important and close neighbour to Australia. The success of the program has been huge and a new phase of the ACIAR scholarship scheme was developed to take it further.

ASEM/2008/033: An assessment of the *Oribius* weevil outbreak in Papua New Guinea and its impact on coffee yield and productivity in Simbu and adjacent provinces

Nearly half of the PNG population benefits from the growing, processing and sale of coffee. Moreover, 70% of PNG's coffee crop is grown in family-owned village gardens. In July 2008, the Coffee Industry Corporation (CIC) reported an *Oribius* weevil epidemic on coffee in the Simbu province of PNG. If this epidemic spreads to other districts and provinces, it has the potential to severely impact on the PNG coffee industry. Spot checks conducted in Simbu revealed the weevil in the Kerowagi, Sinasina/Yogomugl, Gumine, Korowagi and Gembogl districts. Infestations in the Gembogl district were so severe that it has been placed under quarantine and the CIC has taken control of all coffee grown there. The CIC requested help through ACIAR to investigate the epidemic in the hope of stemming the weevil's migration and of finding ways to combat the pest. This small research activity funded a team to investigate the current epidemic and determine the extent of the damage and loss to coffee yield and productivity to date. The team also explored the possibility of and constraints to containment of the epidemic, and identified longer-term research priorities for managing the weevil.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Queensland University of Technology, School of Natural Resource Science, Australia

Project leader

Dr Anthony Clarke
Phone: 07 3138 5023
Fax: 07 3138 2330
Email: a.clarke@qut.edu.au

Project budget

\$7,600

Project duration

01/11/2008 to 30/11/2008

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

The investigating team found that the pest outbreak in Simbu province was unlikely to have been caused by *Oribius* weevil, although these insects may have been present. Sucking bugs of the heteropteran families Pentatomidae and Miridae were suspected to be the most likely causal agents. All insects involved are native, or well-established introductions.

The 'outbreak' had no obvious epicentre and attempts to limit or control it would not have been successful. Pest populations in all areas surveyed had declined naturally over time to very low, non-pest levels.

The 'outbreak' was unlikely to have been an outbreak in the sense of a population explosion—rather, a combination of enhanced public awareness and generally

elevated pest populations due to atypical climatic patterns (especially a wetter 'dry' season) may simply have alerted growers and pest managers to a longer-term, chronic pest problem.

The pest complex attacking coffee is very poorly known. Production losses due to insect damage are likely to be cumulative at all stages of the coffee cycle from pre-harvest to point of sale, but this has not been documented. Given poor information on production losses, economic losses due to insect damage could not be accurately estimated at the time of investigation.

The team reported that options for insect pest management were very limited and those available unlikely to be economically or socially useful to smallholder growers.

Thus, the following recommendations were made:

- Permanent, structured monitoring is urgently recommended to track pest populations and damage levels on coffee in Simbu and neighbouring provinces for the 2008–09 coffee season. Monitoring is needed to confirm if the purported 'outbreak' was a true outbreak, or simply the first notice of a background problem. If a true outbreak, then pest populations are unlikely to reappear now they are gone. If an ongoing background problem, then pest populations should build up to previous levels as the coffee season progresses.
- If damaging pest levels do not occur in 2009, then no further action beyond low-level permanent surveillance is recommended.
- If damaging pest levels do reoccur, then entomological awareness should be proactively integrated into programs seeking to enhance coffee productivity. Under current smallholder production systems, little can be done to control specific pest problems. However, growers should be made aware that promoting healthy, vigorous coffee will not only directly increase yields, but will also lessen losses due to insect attack.

ASEM/2008/034: Socioeconomic impact assessment of cocoa pod borer in East New Britain province, Papua New Guinea

East New Britain province (ENBP) is PNG's largest cocoa producer, accounting for 55% of total exports of cocoa from PNG and over 50% of the province's exports. But cocoa pod borer (CPB) is a major threat to the livelihoods of the province's smallholders. If unchecked, the borer can reduce production by 90%, and this would render the ENBP cocoa industry unviable. CPB was first detected near Kerevat, ENBP, in March 2006, then more infestations were identified in Poro, West Sepik province, in June 2006 and at Bogia, Madang province, in April 2008. Although an eradication program was implemented in ENBP in 2006 and extended into January 2007, CPB re-emerged within the eradication zone in late February 2007 and by June 2008 there were also six confirmed CPB outbreaks outside the eradication zone. The low levels of block maintenance identified in an earlier survey do not augur well for the containment and management of CPB on smallholder cocoa blocks. The aim of this small research activity was to undertake a preliminary assessment of the impact of CPB on smallholder livelihoods.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Curtin University of Technology, Faculty of Media, Society and Culture, Australia

Project leader

Dr George Curry
Phone: 08 9266 3310
Fax: 08 9266 3166
Email: g.curry@curtin.edu.au

Collaborating institution

Cocoa and Coconut Institute of Papua New Guinea, Papua New Guinea

Project budget

\$34,700

Project duration

01/11/2008 to 30/04/2009

ACIAR Research Program Manager

Dr Caroline Lemerle

Project outcomes

The data from surveys in CPB-affected areas in November 2008 indicated that the rate of crop loss was currently at the high end of the scale. Without a major turnaround in the situation, the outlook was gloomy. The economic and social dislocation being experienced by cocoa growers in CPB-affected areas observed in November 2008 could spread to other communities and other sectors of the economy as income and consumption decline. Schools and businesses in villages and towns, for example, were already feeling the impact of CPB through deferred and non-payment of school fees and large falls in business turnover.

If the cocoa industry in ENBP were to collapse, the infrastructure to sustain a cocoa industry would become run-down. This would make it difficult to revive the industry when CPB-resistant material became available from the Cocoa and Coconut Institute (CCI).

Growers and their families in CPB areas had responded to CPB and the loss of cocoa income in several ways: abandoning cocoa production; expansion of other income sources, especially food gardens for home consumption and sale at local markets; establishment of food gardens in cocoa blocks, which often involves the removal of some cocoa trees; diversification into new livelihood activities such as pig production and the cultivation and marketing of tobacco (brus); reliance on relatives (wantoks) in non-CPB areas for cash remittances and access to cocoa or copra income; and theft, especially of food crops from gardens for consumption and sale.

The arrival of CPB in ENBP coincided with an inflationary period of rising prices of store foods. This helped cushion the impact of CPB on rural households because they were expanding garden production for sale at local markets at the same time as the demand for garden foods was growing in response to rising store prices. However, as CPB encroaches into new areas and more cocoa growers switch to food production for sale, the market for garden produce is likely to become saturated. This process will be exacerbated as the amount of cocoa income circulating in the province contracts. With over 70% of ENBP households being involved in cocoa production, the situation is extremely serious.

The survival of the cocoa industry in ENBP depends on smallholder farmers moving to a higher labour input system of production. While this is easy to recommend, it is more difficult to devise strategies to achieve this. The success or failure of introducing a new high-labour input system of cocoa production in ENBP will ultimately determine the future of cocoa production in the province.

The main recommendations contained in this report were:

- develop a strategic plan for agriculture in response to CPB
- establish a project implementation unit to coordinate extension efforts and to raise funding from donors (or from levies) to sustain these programs
- develop an integrated and coordinated approach to extension, involving government, commercial and community organisations
- involve the farming community directly in extension delivery and CPB monitoring
- distribute small hybrid clones free to farmers in return for their removal of old cocoa stands
- promote income and livelihood diversification such as coffee as an alternative crop to cocoa for growers unwilling to transition to high-input cocoa growing
- amend quarantine regulations to allow the removal of CPB hotspots
- CCI Breeding to immediately initiate a crossing program to develop CPB-resistant/tolerant material and, as a shorter-term measure, assess all recent and planned cloned and hybrid releases for CPB tolerance
- encourage growers to alert CCI to any CPB-tolerant cocoa found amongst their own stands—following evaluation and approval from CCI, this material to be budded on their own blocks while waiting for CCI to develop new CPB-resistant/tolerant material
- the Cocoa Board should immediately relax regulations prohibiting the sharing of village-processing facilities, and fast-track the approval of small fermenting boxes for use by growers in CPB areas.

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

Farming fish in ponds is a growing industry in inland areas of PNG. The fish provide protein for rural communities. Several pressing research issues need to be addressed, however, to ensure the industry, dominated by smallholders, remains viable. Through this project, several of these issues were addressed. Research focused on improving the supply of fingerlings to farms, and securing brood-stock and breeding lines at Aiyura in Eastern Highlands province. Farm-based feeds and husbandry for smallholder fish farmers were examined to try to find optimal approaches. Quality-assurance principles were used as the scientists sought to develop a fish-husbandry package. These initiatives helped meet the project's overall aim of improving productivity of inland aquaculture.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of Western Sydney, Australia

Project leader

Dr Paul Smith
Phone: 02 4620 3329
Fax: 02 4620 3025
Email: pt.smith@uws.edu.au

Collaborating institutions

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

Project budget

\$774,751

Project duration

01/01/2005 to 31/12/2008

ACIAR Research Program Manager

Dr Chris Barlow

Project outcomes

By the end of the project the number of active farms had increased from 5,400 to more than 15,000. The farm-gate value of the aquaculture industry increased from K5 million in 2005 to K20 million in 2008. The team, which depended on generous help from farmers, produced four main outputs plus two other minor works. The major outputs were:

- Monograph in 2007: Aquaculture in Papua New Guinea: status of freshwater fish farming. Monograph No. 125. ACIAR: Canberra. 123 pp.

- CD in 2007: Aquaculture in Papua New Guinea: reports from 1950 to 2005. This CD accompanies Monograph 125 and contains 177 unpublished reports plus a comprehensive index on aquaculture in PNG covering the period 1950–2005.
- DVD film in 2009: Raun Raun Pisman (i.e. The Travelling Fishman), 130 minutes.
- Training manual in 2009: Raun Raun Pisman: fish farming in PNG—which accompanies the DVD film, 65 pp.

The team recorded the following achievements: 1. improvements in human capacity; 2. improvements in fingerling production; and 3. improvements in fish nutrition. The 'fish husbandry package' included instructions on all facets of earthen pond-based aquaculture for PNG. A total of 1,460 smallholder farmers at 14 workshops and at 20 cooperator farms in six provinces (i.e. Eastern Highlands, Western Highlands, Morobe, Southern Highlands, Simbu and Madang) learnt about the package.

All project technical officers received training overseas during the project. Also, the project leader used a train-the-trainer approach to mentor the officers when they trained farmers at the workshops and farms. As well, a team-initiated rehabilitation program based on fish farming for prisoners at Bihute Prison is now so well regarded that a request has been received to make this a model for the prison system across PNG.

Fish nutrition was improved by the identification of numerous types of local ingredients and processes for making fish feeds at the farm. In the workshops, farmers learnt how to make feeds and improve nutrition of their fish.

The project developed methods for brood-stock management at Highlands Aquaculture Development Centre (HAQDEC) appropriate for the economic and agricultural conditions in PNG. These methods were used in the breeding program at HAQDEC as well as taught at farms and workshops. 'Natural spawning' and a hatchery program for common carp were developed and this was successfully extended at pioneer smallholder fish farms. Almost 200 women received training at the final women's workshop in smallholder hatchery techniques for common carp.

The team developed a practical husbandry system for farmers to raise Genetically Improved Farmed Tilapia (GIFT) fish and this was extended at workshops. Farmers were trained in sexing fish, keeping males and females in separate ponds, and carrying out breeding with the largest, healthiest and best-formed fish. They have adopted the protocols on a broad scale.

FIS/2009/027: Training in soil assessment and scientific writing for aquaculture officers in Papua New Guinea

In the highlands of PNG, pond-based production of tilapia has been hampered by soil-related problems such as difficulty maintaining plankton blooms (the source of feed for larvae and juvenile fish), erosion, pond leakage and water-quality degradation. One problem is the iron present at high concentrations in the soils of the region, which causes soil acidification and reduces the availability of phosphorus. Consequently, phytoplankton blooms are more difficult to maintain, and this leads to lower pond productivity. Soil acidity also changes the chemical properties of pond waters, slows fish growth and causes increased mortality. Current and future programs to expand freshwater fish farming in PNG will depend on effective liming strategies of pond waters to reduce acidity. Dealing with erosion and pond leakage also depend on an understanding of soil properties. Thus, managers must be able to rapidly assess soils to identify their physical and chemical properties and the associated landscape characteristics that either limit or enhance pond-based production. Soil and land evaluation are also important for mapping areas for site selection at a regional scale. This project will implement in PNG some of the simple, low-cost methods of assessing soils developed in Indonesia during ACIAR projects FIS/1997/022 (*Remediation and management of degraded, earthen shrimp ponds in Indonesia and Australia*) and FIS/2002/076 (*Land capability assessment and classification for sustainable, pond-based aquaculture systems*). The project will also conduct a Communicating Science Workshop to give professional guidance in the preparation and submission of research papers and reports.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

University of New South Wales, Australia

Project leader

Dr Jesmond Sammut
Phone: 02 9385 8281
Fax: 02 9385 1558
Email: j.sammut@unsw.edu.au

Collaborating institutions

James Cook University, Australia
National Fisheries Authority, Papua New Guinea

Project budget

\$59,133

Project duration

01/04/2009 to 30/06/2009

ACIAR Research Program Manager

Dr Chris Barlow

Project outcomes

Final report not yet submitted by the project leader

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

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% 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.

Overseas collaborating countries

Papua New Guinea, Solomon Islands

Commissioned organisation

Australian National University, School of Resources, Environment and Society, Australia

Project leader

Dr Ryde James
Phone: 02 6125 4330
Fax: 02 6125 0746
Email: ryde.james@anu.edu.au

Collaborating institutions

Ministry of Forestry, Environment and Conservation, Solomon Islands
Papua New Guinea Ecoforestry Forum, Papua New Guinea
Papua New Guinea Forest Authority, Papua New Guinea
Secretariat of the Pacific Community, Fiji
Solomon Islands Development Trust, Solomon Islands
University of Melbourne, Australia
University of Technology, Papua New Guinea

Project budget

\$149,989

Project duration

01/04/2005 to 31/08/2008
(Project extended from 01/10/2007 to 31/08/2008)

ACIAR Research Program Manager

Dr Russell Haines

Project outcomes

Final report not yet submitted by the project leader

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

Harvesting of native, primary forests has been an important export industry for PNG. Logs are exported mainly by foreign logging companies, providing very substantial returns totalling hundreds of millions of kina. This money flows to the PNG Government, local communities and landowners. 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. PNG 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 PNG and humid tropical parts of Australia; and secondly, to empower PNG rural communities to raise their own trees.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

CSIRO Forest Biosciences, Australia

Project leader

Mr Brian Gunn

Phone: 02 6281 8258; Fax: 02 6281 8266; Email: brian.gunn@csiro.au

Collaborating institutions

Queensland Department of Primary Industries and Fisheries, Australia

Papua New Guinea Forest Research Institute, Papua New Guinea

The Foundation for People and Community Development Inc., Papua New Guinea

Project budget

\$627,169

Project duration

01/04/2005 to 31/07/2008 (Project extended from 31/03/2008 to 31/07/2008)

ACIAR Research Program Manager

Dr Russell Haines

Project outcomes

Final report not yet submitted by the project leader

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

The island sugarcane planthopper, *Eumetopina flavipes* (Hemiptera: Delphacidae) is the only known vector for Ramu stunt disease of sugarcane. Fortunately, this disease does not occur in Australia, but virus-free populations of this planthopper occur in the Torres Strait Islands (TSI) and northern peninsula area (NPA) of Queensland. In order to mitigate the risk of *E. flavipes* and/or Ramu stunt disease invasion into Australia through the Torres Strait, and to contribute to the development of an integrated-management program for *E. flavipes* in commercial sugarcane plantations at Ramu Sugar Ltd—where Ramu stunt disease continues to impact upon production—project scientists sought a detailed understanding of the population ecology of *E. flavipes* populations throughout PNG and TSI/NPA. They undertook the project through surveys, control trials, establishment of quarantine guidelines and sugarcane-grower education. The project team investigated three major aspects of *E. flavipes* population ecology in PNG and TSI/NPA: 1. the relative effect of host-plant type and distribution on the population structure and demographics of *E. flavipes* in both PNG and TSI/NPA; 2. the large-scale dispersal potential of *E. flavipes* from PNG into TSI/NPA; and 3. the reproductive potential and life-history characteristics of *E. flavipes*. The final goal of the project was to communicate project recommendations to outgrowers at Ramu and to the Australian sugar industry.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Bureau of Sugar Experiment Stations Limited, Australia

Project leader

Dr Robert Magarey
Phone: 07 4068 1488
Fax: 07 4068 1907
Email: rmagarey@bses.org.au

Collaborating institutions

James Cook University, Australia
Ramu Sugar Limited, Papua New Guinea

Project budget

\$149,641

Project duration

01/06/2006 to 31/05/2008
(Project extended from 30/06/2008 to 30/11/2008)

ACIAR Research Program Manager

Dr Richard Markham

Project outcomes

Results show that *E. flavipes* populations are widespread on a range of *Saccharum* host species in PNG, and that despite differing host-plant occupancy rates and abundances between host types, *E. flavipes* is able to effectively use each of them. For

hosts in common to PNG and TSI/NPA, the proportion of plants occupied in PNG was significantly greater than in TSI/NPA. This is likely to be the result of greater overall host-plant density and connectivity in PNG. *Eumetopina flavipes* abundance did not differ significantly per plant between the two regions, suggesting a possible plant-specific abundance and/or dispersal threshold independent of location. While the presence and persistence of *E. flavipes* was highly variable at some TSI/NPA locations, large and stable infestations occurred along the western edge of the Torres Strait archipelago. The stability of these populations appears to be associated with the availability and persistence of host plants, which in turn is significantly affected by variation in cultivation practices.

The location of the large and stable *E. flavipes* infestations did not agree entirely with predictions of *E. flavipes* distribution as simulated by a wind model that projected large-scale, long-distance wind-assisted dispersal from populations along the coast of PNG adjacent to TSI/NPA. The mean number of *E. flavipes* dispersing to the top-western group of islands as predicted by the model did reflect high *E. flavipes* abundance on those islands, but the model also predicted high rates of wind-assisted dispersal to the eastern and central groups of TSI/NPA islands and this was not reflected in survey data.

Eumetopina flavipes is able to survive on cut sugarcane, therefore anthropogenic long-distance dispersal is also feasible. It appears that there may be a relationship between incoming people per island and the proportion of infested plants, but this relationship requires further testing. However, these results suggest that *E. flavipes* may be capable of large-scale natural and anthropogenic dispersal, which may provide high levels of connectivity between islands along the western edge of the TSI/NPA. Despite the planthopper's apparent ability to disperse long distances to the central and eastern islands, colonisation and/or establishment at these locations are likely to be more heavily influenced by processes such as cultivation practices, which were found to greatly affect population persistence.

The reproductive output and life-history parameters investigated during this study indicate that *E. flavipes* populations will increase in size 24-fold per generation from one single reproductive female, under standard environmental conditions. The planthopper can survive large fluctuations in daily temperatures and deteriorating host-plant conditions. Therefore, colonisation following dispersal may be quick and populations may rapidly reach a threshold density that would prompt dispersal, thereby increasing population connectivity. Relative levels of population connectivity are still being tested using microsatellite DNA markers.

The project results strongly suggest that in TSI/NPA, implementation of pre-emptive management of *E. flavipes* via cultivation techniques, such as simultaneous tip-pruning, may be an effective means of control and/or eradication for the pest, and would be a simpler, preferable strategy to the direct management of Ramu stunt disease should it be detected in TSI/NPA. However, in PNG, due to the widespread distribution and persistence of *E. flavipes* across multiple wild and cultivated hosts, management effort should be more focused instead on dealing with Ramu stunt disease—possibly via the planting of new, resistant varieties and vigilant surveillance for new outbreaks of the disease.

PC/2007/098: Development of a mycoinsecticide to control sexava pests in oil palm

Sexava grasshoppers have become the most important pests of oil palm crops in West New Britain and New Ireland provinces and on the main island of Papua New Guinea. Attack by sexava results in a serious reduction of fresh fruit production, and greatly affects the livelihood of smallholder growers with a knock-on effect for the entire industry. The spraying of broad-spectrum chemical pesticides is not a favoured option because it is difficult and unacceptable under the strict environmental standards imposed. Targeted trunk injection remains a more environmentally acceptable option, but it is only effective with systemic insecticides such as organophosphate (OP) compounds. Many OP insecticides have been withdrawn from use and as yet no alternatives have been found. This scoping project looked at the feasibility of using alternative, environmentally friendly control methods in the form of mycoinsecticides, for the purposes of inundative biological control.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

PNG Oil Palm Research Association Inc, Dami Research Station, Papua New Guinea

Project leader

Dr Charles Dewhurst
Phone: 675 985 4009
Fax: 675 985 4040
Email: charles.dewhurst@pngopra.org.pg

Project budget

\$25,001

Project duration

01/03/2008 to 31/12/2008

ACIAR Research Program Manager

Dr Richard Markham

Project outcomes

Three entomopathogenic fungus isolates in the genera *Metarhizium*, *Beauveria* and *Paecilomyces* were obtained, mass-produced and tested against the important oil palm pest *Segestes decoratus* (sexava grasshopper). Earlier work had been marred by high control mortality in bioassays, but in the experiments described here, control mortality (using blank oil formulation) was reduced to an acceptable level. Two experiments were carried out: 1. a bioassay in which 5 microlitres of topically applied oil-based formulation was applied directly to the insects, and 2. a cage test in which the formulation was sprayed onto palm seedlings which were subsequently introduced to insects placed in large cages. The research team established that the spores of all three fungal isolates were still viable in the formulation after application, but there were no significant (or even noticeable) differences in insect mortality between these and control treatments in either experiment. Although this result is interesting from a biological perspective, it is of course disappointing for the management of this important oil palm pest. Potential alternative control methods are now under consideration.

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

Palm oil is the most valuable agricultural commodity in PNG—in the 2000, it was worth about A\$152 million. About 60% of production is in West New Britain province, which has coarse volcanic soils and an annual rainfall of more than 3,000 millimetres. 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 aim of this project was to increase yields of oil palm in PNG by finding suitable ways to overcome deficiencies in Mg and other elements. In particular, the project helped 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.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

CSIRO Land and Water, Australia

Project leader

Dr Michael Webb
Phone: 07 4753 8562
Fax: 07 4753 8600
Email: michael.webb@csiro.au

Collaborating institutions

James Cook University, Australia
PNG Oil Palm Research Association Inc, Papua New Guinea

Project budget

\$987,454

Project duration

01/07/2002 to 30/09/2008
(Project extended from 01/07/2008 to 30/09/2008)

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Project outcomes

This project sought to determine if Mg nutrition was limiting yield, and also assessed alternative strategies for supplying Mg to the palms. In New Ireland, Milne Bay and Morobe provinces, productivity on alluvial and corraline soils is limited by potassium (K) deficiency, and economic responses to K fertiliser (muriate of potash) had been established. However, large losses by leaching were suspected. The scientists traced the fate of applied K in alluvial soils and determined whether uptake efficiency could be improved.

Field trials were established on the volcanic ash soils to assess the effectiveness of fertilisers with different solubility (Mg oxide, Mg carbonate and Mg sulfate) and placement of Mg and K fertilisers on the surface or in buried 'hotspots' with or without barriers to slow leaching loss. Field trials were established on the alluvial soils to determine response to K where it was not yet known, and to assess K placement (broadcast versus concentrated in zones). Leaf nutrient concentrations have responded to treatments in some trials but there have not yet been any consistent yield responses. The trials had been established 1–4 years previously and it is known that responses can take several years to develop, so the intention is for them to continue for 10 years.

The fate of Mg and K applied in fertiliser was determined by measurements in the field and laboratory. The volcanic ash soils had high ability to retain Mg (high cation-exchange capacity) and there was little or no loss from the root zone by leaching, even when Mg was applied as soluble kieserite. In the alluvial soils, there was little or no loss of K and substantial fixation in non-exchangeable form due to the presence of smectite or vermiculite. The retention of K by the soil leads to low uptake efficiency. Modelling of Mg and K transport closely reflected field results, so modelling can be used to predict the fate of fertilisers in new situations.

Uptake of Mg and K, and their distribution through the canopy, were strongly influenced by genotype and also by palm age. Fronds, leaflets and parts of leaflets showing deficiency symptoms (chlorosis) invariably had lower Mg concentrations than plant parts without chlorosis. The research confirmed that frond 17 is still an appropriate frond for diagnosis of Mg and K deficiencies. Maps of nutrient concentrations in smallholder palms indicate clusters of K deficiency. This information can be used to target extension.

Impacts of the research are already apparent, with plantation companies reassessing the type and manner of fertiliser applications. For smallholders, it is clear that overcoming nitrogen deficiency should be the primary aim in most areas. As results from the field trials become clear, the project is expected to have a large economic impact through changed fertiliser-management practices. There has been a major capacity impact due to training of Oil Palm Industry Corporation extension officers, PNG Oil Palm Research Association research staff, smallholder growers and plantation managers in nutrition-related issues.

SMCN/2003/010: Farmer evaluation and multiplication of sweetpotato varieties on the northern coast of Papua New Guinea

Papua New Guinea's 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 sweetpotato leading the way. The crop is now the most important for more than 60% 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 agroecological zones in which sweetpotato is grown makes the likelihood of finding varieties that are more suitable to localised conditions, offering yield boosts, high.

The National Agricultural Research Institute (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 northern 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. The main objective of this project is to evaluate and disseminate appropriate sweetpotato varieties to the rural farming sector along the northern coast of PNG.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

World Vision Australia, Pacific and Latin America Team—International Programs, Australia

Project leader

Ian Grant
Phone: 61 3 9287 2071
Fax: 61 3 9287 2557
Email: ian.grant@worldvision.com.au

Collaborating institutions

Australian National University, Australia
National Agricultural Research Institute, Papua New Guinea

Project budget

\$930,601

Project duration

01/04/2004 to 30/11/2008
(Project extended from 01/08/2007 to 30/11/2008)

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Project outcomes

Final report not yet submitted by the project leader

SMCN/2008/028: Towards a sustainable oil palm industry in Papua New Guinea

In PNG, 18,000 smallholders produce around 700,000 tonnes of oil palm fruit per annum, currently valued at K210 million (around A\$103 million). Production is the mainstay for many rural communities. In major producing areas such as West New Britain and Oro provinces, the target is to increase smallholder oil palm production by 50%. This will involve intensification of blocks currently in production rather than new plantings, and therefore must be based on improvement in smallholder crop husbandry skills, application of fertiliser and management of soil fertility. As well, production increases must be achieved under strict adherence to the principles of the Roundtable on Sustainable Palm Oil (RSPO), in order to meet environmental criteria of sustainability. Thus, as the industry intensifies production and exerts pressure on the land, scientists must monitor soil and landscape 'health'.

This project held two workshops, where major players in the PNG industry under the umbrella of the current RSPO worked with scientists from James Cook University, CSIRO and other Australian institutions. Together they developed a proposal for a major project to develop measurable and quantifiable environmental indicators of sustainability and to model elements of soil, plant and landscape that define interactions in the system and highlight the areas of greatest environmental vulnerability. The project also trained PNG oil palm extension staff, smallholders and PNG researchers working in agriculture, and provided opportunities for researchers to take up postgraduate opportunities in Australia.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

James Cook University, Australia

Project leader

Dr Paul Nelson
Phone: 07 4042 1375
Fax: 07 4042 1284
Email: paul.nelson@jcu.edu.au

Collaborating institutions

CSIRO Land and Water, Australia
PNG Oil Palm Research Association Inc., Papua New Guinea

Project budget

\$49,849

Project duration

01/01/2009 to 30/06/2009

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Project outcomes

The project reported that the area of planted oil palm is small (134,000 ha) compared to Indonesia and Malaysia and there are restrictions to the rate of expansion. Nevertheless, the future expansion of the industry in relation to conservation of lowland forests and surrounding ecosystems must be considered at regional and national levels. In this project, the researchers did not consider the planning issue in depth, but concentrated on the effects of oil palm cultivation on soil, water and atmosphere.

Balances of carbon, energy and water in oil palm are generally favourable, being similar to forest, but nutrient balances are different, with higher inputs and exports from oil palm. The main concern regarding carbon balance is the substantial losses of carbon to the atmosphere when forest is converted to oil palm. Throughout most of the growing cycle, oil palm has large rates of net primary productivity and carbon sequestration. Fertilisers must be applied and/or legumes grown to sustain productivity and losses of nutrients to the environment occur, particularly nitrogen. Erosion losses appear to be small but leaching loss of nitrate is known to be significant. The project found that the amount of biological nitrogen fixation that occurs through the crop cycle, and the losses of nitrogen by leaching and as gas are the least understood and potentially most environmentally sensitive nutrient-balance issues.

The quality of water and health of streams is likely to be affected by losses of nutrients, particularly nitrogen, from oil palm cultivation. The magnitude of the effects is unknown and is likely to be highly variable in space and time. Losses of sediments from oil palm blocks appear to be small, but inputs from enhanced stream-bank erosion and sand-extraction operations may be significant. Losses of pesticides are likely to be small, given their targeted use (weeded circle for herbicides and trunk injection for insecticides, and nurseries).

Maintenance of soil health in oil palm blocks is critical for sustainability. Soil erosion is potentially the most destructive influence on soil health, but it is generally low in PNG oil palm blocks. It can be minimised by good planning, encouraging good ground cover, and good design of roads. The main threat to soil health appears to be acidification, resulting from removal of cations and leaching loss of nitrate. In order to ensure and improve environmental sustainability of oil palm cultivation into the future, the industry and research providers should endeavour to:

- identify the main risks and options for managing risks to environmental sustainability in and around smallholder blocks and plantations, with particular reference to soil and water resources
- develop environmental sustainability indicators to underpin RSPO principles and criteria and to aid growers improve management practices
- establish and implement management practices that ensure environmental sustainability.

SMCN/2008/032: Sustainable vegetable production in Central province, Papua New Guinea

Vegetable crops are traditional staple foods in PNG and have been the major contributor to food supply and security for many years. Central province has great potential to produce a wide range of vegetables—cabbages, broccoli, onions and others—but currently production is not sufficient to meet the increasing demand. Soil fertility decline, pressure on land and renewable resources from population increase, pests and diseases, and lack of market information are some of the major constraints to improving the vegetable industry. The main objective of this small research activity was to identify key research areas where there is potential to increase the productivity of vegetable-cropping systems in Central province and thus improve the livelihoods of smallholder vegetable growers. The project team held a series of meetings and workshops with various stakeholders to assess the potential research activities that will address constraints to improving vegetable production. Particular focus areas were natural-resource management, marketing and socioeconomics. The final report is forming the basis of a full research proposal designed to lead into a project of 4 years duration.

Overseas collaborating country

Papua New Guinea

Commissioned organisation

Tasmanian Institute of Agricultural Research, Vegetable Centre, Australia

Project leader

Associate Professor Colin Birch
Phone: 03 6430 4938
Fax: 03 6430 4959
Email: colin.birch@utas.edu.au

Collaborating institutions

Fresh Produce Development Agency Ltd, Papua New Guinea
National Agricultural Research Institute, Papua New Guinea

Project budget

\$57,716

Project duration

01/05/2009 to 31/08/2009
(Project extended from 01/07/2009 to 31/08/2009)

ACIAR Research Program Manager

Dr Gamini Keerthisinghe

Project outcomes

The project achieved its main objectives, emphasising the importance of a participatory approach and of consulting the appropriate stakeholders in identifying R&D issues. The report provided valuable information on R&D issues related to vegetable production in PNG and recommendations for ACIAR's future research, and is now the basis for development of a large project on sustainable and profitable vegetable production in the Central province of PNG.

7 Impact Assessment Program

ACIAR has a long history of assessing the impact of its research and development (R&D) investments. These assessments have provided valuable lessons in improving the selection, design and delivery of R&D projects. They have also been useful for demonstrating the value of ACIAR as part of Australia's international development assistance program. The two main types of finished project assessments are adoption studies and impact assessments.

Adoption studies became part of ACIAR's evaluation strategy in 2003–04. They are undertaken by project leaders on completed projects where ACIAR expenditure was greater than \$400,000, and for which there is no follow-on project. The primary purpose of these evaluations is to provide information on the uptake of the project results, three years after a project's completion. In addition, where there has been no adoption, information on the reasons for the lack of uptake is sought. Information from adoption studies, of which over 50 have been completed to date, is used to support ACIAR's investment decision-making process, in project development and design and in the selection of projects for impact assessment.

Impact assessments involve extensive analysis of the adoption and impact of the project results, both in the partner country or countries and in Australia. Over the last six years, there has been an increased focus on undertaking thematic impact assessments, rather than assessing the impact of individual projects. The credibility of ACIAR impact assessments has been enhanced by several meta evaluations and the use of independent consultants to undertake the studies. In addition, stratified random-sampling techniques are used, where practical, to select projects for impact assessments. ACIAR has also published guidelines for assessing the impacts of its research activities to ensure rigour and consistency in all future assessments.

As part of the evaluations, areas for practical methodology innovations were identified and some advances in impact assessment methods were made. In recent years, the focus has been on developing and implementing frameworks to measure the returns to ACIAR's investment in capacity building. Over 50 full benefit–cost assessments have been published in ACIAR's impact assessment series.

ACIAR has developed a database for systematically recording all the adoption studies and impact assessments and providing important summary information to support decision-making. This continues to be developed, expanded and refined to ensure maximum use is made of the results of these impact assessment efforts.

ACIAR has begun the process of linking its impact assessment work to the activities of the Australian Government's Office of Development Effectiveness and will strengthen this link during 2009–10.

7.1 Impact assessments undertaken in 2008–09

This year, five impact assessment studies were undertaken, with details reported below. The ACIAR Database for Impact Assessments became operational, with a report describing the framework and functionality of the database published in the Impact Assessment Series. The database allows a comprehensive update of previous analysis of returns to ACIAR's investments in R&D. Based on an analysis of the quantitative information obtained from 37 ACIAR impact assessment studies, the total cost of the investment in these projects is around \$234 million in net present value terms (2008 dollar equivalents). Of these costs, \$128 million are direct ACIAR costs. In total, these projects generated an estimated total benefit of \$12.6 billion, with the benefits attributable to ACIAR being \$6.8 billion. The benefit:cost ratio for all the projects evaluated is around 54:1.

This study also contained a significant qualitative element, which involved drawing evidence on the appropriateness, effectiveness and efficiency of ACIAR's activities within the broad context of Australia's aid delivery system. There is a particular emphasis on whole-of-government and public good issues, which demonstrates that ACIAR is an effective and efficient funding agency. Despite its relatively small size on the international aid and research for development arena, ACIAR performs well, ensuring that the research it invests in meets the needs of its stakeholders, makes a difference to the livelihoods of the poor and aligns within the broader Australian aid program.

Two-stage grain drying in the Philippines

Grain drying is a major issue in all grain-producing countries, presenting particular problems in humid, tropical climates. ACIAR and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, in association with other Philippine research organisations, supported a major effort in this area dating back to the early days of ACIAR's activities. The assessment indicated that the grain-drying technologies had not been adopted in the Philippines despite evidence of adoption in other collaborating countries in the Asian region and in Australia. This lack of adoption and impact was due to the structure of the grain industry in the Philippines, with the grain-trading industry dominated by small-scale operators. As a consequence, economies of scale do not exist in grain trading, and the grain-drying technologies developed are therefore currently not profitable. These lessons will help guide future investments in research, in particular the interactions between local industry and policy conditions and research activities. The analysis undertaken suggests that, if the structure of the grain industry in the Philippines changes, application of the grain-drying technologies developed could yield returns as high as those gained in other countries.

ACIAR Database for Impact Assessments (ADIA): an outline of the database structure and a guide to its operation

This report describes the development of a database established as the repository of information from impact assessments. The database provides a mechanism to choose a stratified random sample of completed projects for impact assessment. As well, on the basis of the data entered, the database can be used to manipulate information and present it in various forms for reporting and analytical purposes.

Salinity reduction in tannery effluents in India and Australia

The tanning industry is an important contributor to economic output in India, particularly in the state of Tamil Nadu, which produces around 60% of India's total leather production. Tannery effluent, however, is high in salinity and has caused significant environmental damage, including increased salinity in groundwater and river systems, contaminating productive agricultural land and drinking water. Reducing the salinity of effluent was a common challenge for both Indian and Australian tanners. ACIAR provided funding of \$0.8 million in nominal terms out of a total budget of \$1.9 million for a project to reduce the salinity of tannery effluent by developing technologies that reduced salt inputs. The project was undertaken by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Textile and Fibre Technology in partnership with the Central Leather Research Institute in India. It is estimated that, in constant 2008–09 dollars, the project will deliver benefits to Indian tanners of around \$62.0 million in present value terms, using a discount rate of 5%. Of these total benefits, \$28.1 million can be attributed to ACIAR on a cost-share basis, resulting in a net benefit of \$59.9 million; a benefit of \$29.60 for every dollar spent. The internal rate of return on the project is estimated to be 35.1%.

Integrated management of insect pests of stored grain in the Philippines

Protecting stored grain in tropical areas relies on the use of pesticides. ACIAR supported a series of four research projects to develop effective alternative control options for major pests of stored grains in the tropical areas of Australia, the Philippines, Malaysia, Thailand and China. The combined research involved the Bureau of Postharvest Research and Extension and two research groups in Australia—the Queensland Department of Primary Industries and CSIRO. This assessment focused on the impact in the Philippines and, through surveys of members of the grain sector, found that there has been significant adoption of the outcomes. This has been primarily by the larger storage and handling sectors of the rice and other grain industries. The study found that the return on this significant investment by all parties was substantial, with a net present value of research gains to the Philippines of \$1,696 million. This provides a benefit:cost ratio of approximately 174:1 and an internal rate of return of 46.6%.

Analysis of ACIAR's returns on investment: appropriateness, efficiency and effectiveness

Following the development of an impact assessment database, a study was commissioned to analyse the results of 37 quantitative impact assessments. In total, the benefits to ACIAR research calculated in these impact assessments are estimated at \$12.6 billion for a total investment of approximately \$234 million in 2008 dollar present value terms. Of the total benefits, \$11.4 billion accrued to developing countries, with \$1.2 billion in benefits to Australia. The average benefit:cost ratio across all assessed projects is 54. Of the \$12.6 billion, the benefits directly attributable to ACIAR funding are estimated at \$6.8 billion for an investment of \$128 million across the assessed projects. Given that total ACIAR expenditure since inception is estimated at \$2.1 billion, the returns from assessed research effectively pay for total expenditure more than three times over.

This impact assessment demonstrates the appropriateness, effectiveness and efficiency of ACIAR-funded research over a long period of time. A key finding is the importance of partner-country scientific, research and extension capacity. ACIAR's research tends to be more successful in countries with strong capacity in these areas, while countries where uptake of ACIAR research has been low tend to have lesser in-country capacity. Alignment of priorities agreed by partner countries and ACIAR is also an important factor in uptake of research.

7.2 Impact assessments planned for 2009–10

Key performance indicators

- at least five impact assessment studies of completed projects published
- impact assessment review of at least one thematic area in Indonesia
- impact assessment of at least one thematic area in Papua New Guinea (PNG)
- assessment of the impact of international agricultural research centre (IARC) activities in ACIAR's mandate region
- 2009–10 project leader adoption studies published for selected projects completed in 2005–06
- links established with partner-country, IARC and Australian impact assessment groups.

Key priorities

Project-specific

- Publish five assessments in 2009–10 of the impacts of completed projects (this year, with an emphasis on increasing the number of impact assessments undertaken in ACIAR's two largest partner countries, Indonesia and PNG)
- Where possible and appropriate, increase emphasis on the type and quantity of data used in the impact assessments, in an effort to further strengthen their rigour and credibility
- Review and publish the 2009–10 project leader adoption studies for the set of large projects concluded in 2005–06.

Capacity building

- Develop collaboration with Consultative Group on International Agricultural Research (CGIAR) centres in impact assessment activities, particularly of projects jointly funded through ACIAR
- Provide feedback on the implications of impact assessment studies for research project development and management within ACIAR, through 'lessons learnt' style meetings with all staff
- Enhance clarification and estimation of the outcomes of new projects, by assisting project research groups during peer review of their proposals and by including impact analysis in the project design; in particular, provide summaries of the implications of impact studies to meetings of these groups.

Thematic studies

- Review the application and impact of ACIAR natural resource management research activities in the Philippines
- Undertake an assessment of ACIAR's animal health and/or forestry research in Indonesia
- Commission a comprehensive review of all ACIAR impact assessment studies. This will expand its focus to include issues such as the public good basis for funding this type of collaborative research. It will also disaggregate the benefits to more accurately identify those attributed to other funders of the research and, especially, the development; and will look particularly for whole-of-government and between-government interactions; for example, the shares of benefits to other aid donors such as the Australian Agency for International Development (AusAID)
- Commission two studies to assess the impact of IARC activities in ACIAR's mandate region—the first, review of past CGIAR impact assessment studies and development of an overview of the impact on the Asia–Pacific region and individual countries within this region; and the second, an assessment of the impact of at least one centre's genetic improvement program in ACIAR's mandate countries
- Work closely with the Office of Development Effectiveness (ODE) to ensure ACIAR's impact assessment work maintains close links with the ODE's activities.

8 Appendix 1: ACIAR Contacts

8.1 Country Office

TBA Country Manager

8.2 R&D Program

Dr Gamini Keerthisinghe	Regional Coordinator
Email	keerthisinghe@aciarc.gov.au
Phone	+61 2 6217 0558
Ms Helen Laughlin	Regional Coordinator Assistant
Email	laughlin@aciarc.gov.au
Phone	+61 2 6217 0538
Ms Lisa Wright	Governance and Communications
Email	wright@aciarc.gov.au
Phone	+61 2 6217 0535

Key Program Managers

Dr Caroline Lemerle	Agricultural Systems Management
Email	lemerle@aciarc.gov.au
Phone	+61 2 6217 0532
Dr Chris Barlow	Fisheries
Email	barlow@aciarc.gov.au
Phone	+61 2 6217 0508
Dr Russell Haines	Forestry
Email	haines@aciarc.gov.au
Phone	+61 2 6217 0549
Dr Richard Markham	Pacific Crops
Email	markham@aciarc.gov.au
Phone	+679 337 9392
Dr Gamini Keerthisinghe	Soil Management and Crop Nutrition
Email	keerthisinghe@aciarc.gov.au
Phone	+61 2 6217 0558

9 Appendix 2: ACIAR Publications

This is a list of ACIAR publications produced in 2008–09. Print copies are available by emailing <comms@aciarc.gov.au>, or electronic versions may be downloaded from ACIAR's website <www.aciarc.gov.au>.

Monographs	
120c	<i>Better-practice approaches for culture-based fisheries development in Asia</i> [Tamil translation], Sena S. De Silva, Upali S. Amarasinghe and Thuy T.T. Nguyen (eds), 2009, 117 pp.
120d	<i>Better-practice approaches for culture-based fisheries development in Asia</i> [Sinhalese translation], Sena S. De Silva, Upali S. Amarasinghe and Thuy T.T. Nguyen (eds), 2009, 115 pp.
129a	<i>Diagnostic manual for plant diseases caused by fungi and fungal-like pathogens</i> [Vietnamese translation], Lester W. Burgess, Timothy E. Knight, Len Tesoriero and Phan Thuy Hien, 2009, 210 pp.
134	<i>Growing peanuts in Papua New Guinea: a best management practice manual</i> , Michael Hughes, Rao C.N. Rachaputi, Lastus Kuniata and A. Ramakrishna, 2008, 77 pp.
135	<i>Sea cucumber fisheries: a manager's toolbox</i> , K. Friedman, S. Purcell, J. Bell and C. Hair, 2008, 34 pp.
136	<i>Measuring plant-associated nitrogen fixation in agricultural systems: theory and practice</i> , Murray Unkovich, David Herridge, Mark Peoples, Georg Cadisch, Bob Boddey, Ken Giller, Gruno Alves and Phillip Chalk, 2008, 258 pp.
137	<i>Jorani and the green vegetable bugs</i> [in English], Bob Martin and Deb White, 2009, 48 pp.
137a	<i>Jorani and the green vegetable bugs</i> [Khmer translation], Bob Martin and Deb White, 2009, 48 pp.
138	<i>Landcare in the Philippines: a practical guide to getting it started and keeping it going</i> , Landcare Foundation of the Philippines, Inc., 2009, 144 pp.

Proceedings	
128	<i>Management of classical swine fever and foot-and-mouth disease in Lao PDR</i> , J.V. Conlan, S.D. Blacksell, C.J. Morrissy and A. Colling (eds), 2008, 100 pp.
129	<i>Silvicultural management of bamboo in the Philippines and Australia for shoots and timber</i> , David J. Midmore (ed.), 139 pp.
130	<i>Efficient nutrient use in rice production in Vietnam achieved using inoculant biofertilisers</i> , I.R. Kennedy, A.T.M.A. Chudhury, M.L. Kecskés and M. Rose (eds), 2008, 136 pp.

Impact Assessment Series Reports	
59	<i>Two-stage grain drying in the Philippines</i> , Agnes Chupungco, Elvira Dumayas and John Mullen, 2008, 50 pp.
60	<i>ACIAR Database for Impact Assessments (ADIA): an outline of the database structure and a guide to its operation</i> , Centre for International Economics, 2009, 38 pp.
61	<i>Salinity reduction in tannery effluents in India and Australia</i> , Hayden Fisher and David Pearce, 2009, 53 pp.
62	<i>Integrated management of insect pests of stored grain in the Philippines</i> , S.R. Francisco, M.C. Mangabat, A.B. Mataia, M.A. Acda, C.V. Kagaoan, J.P. Laguna, M. Ramos, K.A. Garabiag, F.L. Paguia and J.D. Mullen, 2009, 45 pp.
63	<i>Analysis of ACIAR's returns on investment: appropriateness, efficiency and effectiveness</i> , Matthew Harding, Tingsong Jiang and David Pearce, 2009, 37 pp.

Final reports	
2008-19a	<i>Development of an embryo culture manual and an embryo transplantation technique for coconut germplasm movement and seedling production of elite coconut types [HORT/2006/006]</i> [Vietnamese translation], Stephen W. Adkins, Erlinda Rillo and Osmundo Orense, 2008, 29 pp. < http://www.aciar.gov.au/publication/FR2008-19a >
2008-19b	<i>Development of an embryo culture manual and an embryo transplantation technique for coconut germplasm movement and seedling production of elite coconut types [HORT/2006/006]</i> [Indonesian translation], Stephen W. Adkins, Erlinda Rillo and Osmundo Orense, 2008, 29 pp. < http://www.aciar.gov.au/publication/FR2008-19b >
2008-35a	<i>Agricultural water-use efficiency in north-western China [LWR/2002006/076]</i> [Mandarin translation], Philip Young, David Marston, Wang Jinxia and Li Xiande, 2008, 100 pp. < http://www.aciar.gov.au/publication/FR2008-35a >
2008-36	<i>Facilitating farmer uptake of ACIAR project results: World Vision collaborative program [PLIA/2000/165]</i> , Soda Souvannaphong, Jonathan Treagust, John Schiller, Siddhartha Sahu, Monthathip Chanphengxay, Phoudalay Lathvilayvong and Phoumi Inthapanya, 2008, 42 pp. < http://www.aciar.gov.au/publication/FR2008-36 >
2008-37	<i>Increasing milk production from cattle in Tibet [LPS/2002/104]</i> , John Wilkins, John Piltz, Kristy Bailes, Colin Griffiths, Se Zhu, Tsamyu Osman and Nyima Tashi, 2008, 54 pp. < http://www.aciar.gov.au/publication/FR2008-37 >

2008-38	<i>A sea cucumber fisheries management project in Papua New Guinea: a project feasibility review to ACIAR [FIS/2006/133]</i> , Alistair McIlgorm, Bob Lindner and Jeff Kinch, 2008, 32 pp. < http://www.aciar.gov.au/publication/FR2008-38 >
2008-39	<i>Genetic and morphological relationships of mud crabs, genus Scylla, from throughout the Indo–Pacific [FIS/1992/017]</i> , C.P. Keenan, D. Mann, S. Lavery and P. Davie, 2008, 74 pp. < http://www.aciar.gov.au/publication/FR2008-39 >
2008-40	<i>Improving smallholder crop–livestock systems in eastern Indonesia [LPS/2004/005]</i> , Shaun Lisson, Neil MacLeod, Cam McDonald, Jeff Corfield, Lalu Wirajaswadi, Rahmat Rahman, Syamsu Bahar, Nasruddin Razak, Ketut Puspadi, Dahlanuddin, Yusuf Sutaryono, Rusnadi Padjung, Sania Saenong, Lia Hadiawati, Sahardi Mashur and Dwi Proptomo, 2008, 212 pp. < http://www.aciar.gov.au/publication/FR2008-40 >
2008-41	<i>Establishment of beef industries in additional red soils provinces in China [PLIA/2006/151]</i> , R.A. Hunter, J.V. Nolan, N.D. MacLeod, Xu Minggang and Wen Shilin, 2008, 14 pp. < http://www.aciar.gov.au/publication/FR2008-41 >
2008-42	<i>Impact of migration and off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems [PLIA/2000/039]</i> , Thelma R. Paris, Fay Rola-Rubzen, Truong Thi Ngoc Chi, Chaicharn Wongsamun and Joyce S. Luis, 2008, 56 pp. < http://www.aciar.gov.au/publication/FR2008-42 >
2008-43	<i>Horticulture industry development for market-remote communities: Cape York and Samoa [HORT/2001/023]</i> , Rowland Holmes, Roger Boebel, Philip Tuivavalagi, Jeff Daniells and Mafutaga Tinifu, 2008, 82 pp. < http://www.aciar.gov.au/publication/FR2008-43 >
2008-44	<i>Developing profitable beef business systems for previously disadvantaged farmers in South Africa [LPS/1999/036]</i> , Heather Burrow, Ephraim Matjuda, Phillip Strydom, Baldwin Nkhane Nengovhela, Percy Madzivhandila, Dan Motiang, Garry Griffith and Richard Clark, 2008, 45 pp. < http://www.aciar.gov.au/publication/FR2008-44 >
2009-12	<i>Improving sustainability and profitability of village sea cucumber fisheries in Solomon Islands [FIS/2003/051]</i> , A. Schwarz, D. Boso, C. Ramofafia, N. Andrew and W. Nash, 2009, 69 pp. < http://www.aciar.gov.au/publication/FR2009-12 >
2009-13	<i>Increasing the productivity of cattle in India and Australia with rumen fungal treatments [AH/1997/058]</i> , C.S. McSweeney, K.T. Sampath, C.S. Prasad and S.E. Denman, 2009, 55 pp. < http://www.aciar.gov.au/publication/FR2009-13 >
2009-14	<i>Salinity reduction in tannery effluents in India and Australia [AH/2001/005]</i> , Catherine A. Money, T. Ramasami, N.K. Chandra Babu, C. Muralidharan, J. Ragava Rao, P. Saravanan, A. Amudeswari, A.B. Mandal, Ken Montgomery, Mark Hickey, Cameron Simpson, Chi Huynh and Rita Siekris, 2009, 51 pp. < http://www.aciar.gov.au/publication/FR2009-14 >

2009-15	<i>Evaluating domestic tuna fisheries projects [ASEM/2004/011]</i> , Harry Campbell, Ronald Kuk, Margaret Ame, Len Rodwell and Linda Kaua, 2009, 38 pp. < http://www.aciar.gov.au/publication/FR2009-15 >
2009-16	<i>Development of a vaccine for the control of Gumboro in village and small-poultry holdings in Indonesia [AH/2000/083]</i> , Jagoda Ignjatovic and Lies Parede, 22 pp. < http://www.aciar.gov.au/publication/FR2009-16 >
2009-17	<i>Farming systems research for crop diversification in Cambodia and Australia [ASEM/2000/109]</i> , Bob Martin, Bob Farquharson, Fiona Scott, Stephanie Belfield and Chan Phaloeun, 2009, 27 pp. < http://www.aciar.gov.au/publication/FR2009-17 >
2009-18	<i>Microbial contaminants associated with sago processing and storage in Papua New Guinea [ASEM/2001/016]</i> , Jeffrey Warner, Andrew Greenhill and Mary Fletcher, 2009, 74 pp. < http://www.aciar.gov.au/publication/FR2009-18 >
2009-19	<i>Economic performance and management of the Gulf of Papua prawn fishery [ASEM/2002/005]</i> , Tom Kompas and Ronald Kuk, 2009, 16 pp. < http://www.aciar.gov.au/publication/FR2009-19 >
2009-20	<i>Inland pond aquaculture in Papua New Guinea: assessment of the industry and evaluation of smallholder research and development needs [FIS/2001/034]</i> , Paul T. Smith, Augustine Mobiha, Jacob Wani, Kine Mufuape, Kaupa Kia, Micah Aranka, Wally Solato and Hopa Simon, 2009, 11 pp. < http://www.aciar.gov.au/publication/FR2009-20 >

Fact Sheets	
Impact assessment fact sheets	
1	<i>Fruit-fly research yields impacts in the Asia–Pacific region</i> , 2008, 2 pp.
2	<i>Sustaining Indonesia’s fisheries</i> , 2009, 4 pp.
2a	<i>Sustaining Indonesia’s fisheries</i> [Indonesian translation], 2009, 4 pp.
Program fact sheets	
1	<i>ACIAR–SADI [Smallholder Agribusiness Development Initiative] program updates</i> , 2009, 17 facts sheets, total 39 pp.
2	<i>Growing livelihoods from farming</i> , 2009, 2 pp.

Corporate publications	
	<i>Annual Operational Plan 2008–09</i> , 2008, 116 pp.

	<i>Annual Operational Plan 2008–09: Indonesian, Vietnamese, Cambodian and Lao extracts</i> , 2008.
	<i>ACIAR Annual Report 2007–08</i> , 2008, 250 pp.
	<i>ACIAR Annual Report and Publications 2007–08</i> CD-Rom, 2008.
	<i>ACIAR Country Profiles 2008–09: China</i> (71 pp.), Cambodia, Lao PDR, Thailand (132 pp.), Indonesia (178 pp.), Pacific islands (95 pp.), Papua New Guinea (111 pp.), Philippines (73 pp.), South Asia (135 pp.), Vietnam (94 pp.), 2008.
	<i>ACIAR Corporate Plan 2008–2012</i> , 2008, 26 pp. < http://www.aciar.gov.au/publication/CP14 >
	<i>The John Allwright Fellowship scheme: survey report 2008</i> , Felicity Muller and Jessica Morton, 2008, 48 pp.
	<i>Partners in Research for Development</i> magazine: November 2008 – February 2009, March–June 2009, July–October 2009
	<i>Adoption of ACIAR project outputs: studies of projects completed in 2004–05</i> , D. Pearce and D. Templeton (eds), 2009.



ACIAR

Research that works for developing
countries and Australia

www.aciar.gov.au

ACIAR is an Australian Government Statutory Authority that operates within the portfolio of Foreign Affairs and Trade. ACIAR aims to enhance rural household incomes and broader economic growth by investing in international research partnerships that encourage agricultural development, sustainable use of natural resources and capacity-building to benefit partner countries and Australia.

ACIAR works collaboratively with AusAID in areas of mutual priority, with both organisations contributing to the whole-of-government emphasis of the aid program.

ACIAR • GPO Box 1571, Canberra ACT 2617
Tel: +61 2 6217 0500 • Fax: +61 2 6217 0501
Email: aciara@aciara.gov.au