

**ACIAR COUNTRY PROFILES 2008–09:
PACIFIC ISLANDS**



ACIAR

Research that works for developing
countries and Australia

www.aciar.gov.au

2008

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1 Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of 33 projects that are active in 2008-09. There are another 7 projects under development, which are expected to start in 2008-09 financial year.

This publication also sets out the key outputs and outcomes from 7 projects that have been completed in 2007-08.

In addition to these project summaries, the publication includes information on ACIAR's work, including its training program, the Pacific Islands chapter from the Annual Operational Plan 2008-09 and the 2007-08 Annual Report.

ACIAR updates this profile each year and distributes it to key stakeholders in the Pacific Islands and Australia.

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



Peter Core
Chief Executive Officer
November 2008

2 Overview

2.1 About ACIAR

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

ACIAR 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.

Australia is in a particularly strong position to provide such assistance because it has a broad range of climates – cool and warm temperate, subtropical and tropical – that are typical of the Asia-Pacific region.

ACIAR-funded research harnesses Australia's outstanding strengths in agricultural research to develop partnerships with developing-country institutions. This research is mutually beneficial as the similar environments allow the results to be used in Australia and developing countries.

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

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 the 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.

2.2 ACIAR's program in Pacific Islands

Fiji

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

ACIAR's program with Fiji as at 30 June 2008.

Bilateral Program

Active projects	14 with a value over their lifetime of approximately \$7.840 million
Projects under development	4
Completed projects	50

Multilateral Program

Active projects	0 with a value over their lifetime of approximately \$0
Projects under development	0
Completed projects	2

Samoa

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

ACIAR's program with Samoa as at 30 June 2008.

Bilateral Program

Active projects	5 with a value over their lifetime of approximately \$0.233 million
Projects under development	0
Completed projects	25

Multilateral Program

Active projects	0 with a value over their lifetime of approximately \$0 million
Projects under development	0
Completed projects	1

Solomon Islands

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

ACIAR's program with the Solomon Islands as at 30 June 2008.

Bilateral Program

Active projects	11 with a value over their lifetime of approximately \$6.198 million
Projects under development	1
Completed projects	30

Multilateral Program

Active projects	4 with a value over their lifetime of approximately \$2.747 million
Projects under development	0
Completed projects	7

Tonga

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

ACIAR's program with Tonga as at 30 June 2008.

Bilateral Program

Active projects	5 with a value over their lifetime of approximately \$2.376 million
Projects under development	0
Completed projects	37

Multilateral Program

Active projects	0 with a value over their lifetime of approximately \$0
Projects under development	0
Completed projects	2

Vanuatu

ACIAR has supported a program of collaborative agricultural research with Vanuatu since 1984. Most of the program consists of bilateral projects, in which an Australian research organisation is commissioned to undertake a specified research activity in collaboration with a partner organisation in Vanuatu. Vanuatu is also targeted in ACIAR's multilateral program delivered in conjunction with the international agricultural research centres.

ACIAR's program with Vanuatu as at 30 June 2008.

Bilateral Program

Active projects	6 with a value over their lifetime of approximately \$3.190 million
Projects under development	0
Completed projects	29

Multilateral Program

Active projects	0 with a value over their lifetime of approximately \$0
Projects under development	0
Completed projects	1

Pacific Island focus

The research program in the Pacific Islands is on Fiji, Solomon Islands, Vanuatu, Samoa and Tonga, looking at the following agricultural priorities:

- Improving household incomes and food security through more productive and diverse farming systems, including:
 - root, horticultural and plantation crop management and marketing
 - village production and value addition to forest products
 - community aquaculture and mariculture
- Stock assessment and planning for sustained use of inshore fisheries
- Biosecurity and quarantine issues
- Work with both Pacific regional organisations and individual countries

Reflecting these priorities, the research program is split into the following subprograms:

Subprogram 1: Improving household incomes and food security through more productive and diverse farming systems

Subprogram 2: Sustainable use and management of forestry and fishery resources

Subprogram 3: Farming systems economics, marketing and biosecurity

2.3 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 2008–09 of approximately \$5.38 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), including support for the Crawford Fund
- On-the-job training.

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 Fellowship

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.

John Allwright Fellowships in Fiji

		PhD	MSc/Other
Active	Male	2	2
	Female	1	1
Concluded	Male	1	3
	Female	0	1

John Allwright Fellowships in Somoa

		PhD	MSc/Other
Active	Male	1	0
	Female	0	1
Concluded	Male	0	0
	Female	0	0

John Allwright Fellowships in Solomon Islands

		PhD	MSc/Other
Active	Male	1	1
	Female	1	0
Concluded	Male	1	1
	Female	0	0

John Allwright Fellowships in Tonga

		PhD	MSc/Other
Active	Male	0	0
	Female	1	0
Concluded	Male	2	2
	Female	0	0

John Allwright Fellowships in Vanuatu

		PhD	MSc/Other
Active	Male	0	0
	Female	0	0
Concluded	Male	0	0
	Female	0	1

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 they are involved in. 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 Fellowship

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.

2.4 Policy Advisory Council member

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

The current member from the Pacific Islands is Mr Peter Forau, Deputy Secretary General, Pacific Islands Forum Secretariat. Mr Forau has been a member of the Council since March 2005.

3 Pacific Islands chapter from the Annual Operational Plan 2008–09

Population (millions)	2	Bilateral estimate 2007–08	\$2.8 m
Projected population (millions) 2015	2	Bilateral budget 2008–09	\$2.4 m
Active bilateral projects	26	Bilateral + multilateral budget 2008–09	\$3.0 m
Active multilateral projects	3		

GDP per capita (PPP ^a US\$)			
Fiji	6,049	Samoa	6,170
Solomon Islands	2,031	Tonga	8,177
Vanuatu	3,225		

^aPurchasing power parity (see Appendix 3, Selected world development indicators)

3.1 Medium-term strategy

ACIAR’s program in the Pacific islands countries concentrates on Fiji, Solomon Islands, Samoa, Tonga and Vanuatu. Our strategy recognises the importance of the agricultural, fisheries and forestry sectors within these countries. It supports research, capacity building and adoption of the results of previous research to underpin increases in household income and economic growth, and assist with the reduction of unemployment and improvement in food security. The strategy supports research to address three thrusts: increased productivity and diversification through new crops, products and value adding; development of sustainable forestry and fisheries management systems; underpinning of marketing and biosecurity.

In agriculture, the program will focus on identification and management of constraints to productivity in high-value crops, and identification and development of new high value horticultural crops (fruits, vegetables and ornamentals) for domestic and inter-island

markets. In fisheries, ACIAR will focus on addressing sustainable production of oceanic and inshore fisheries, and on development of aquaculture alternatives and improvements in economic returns in quality, marketing and value-adding activities. The forestry program will focus on development of emerging plantation opportunities through improved silviculture management, enhanced genetic resources, and development of disease and pest detection and control methods.

There will be increased attention to improved processing and product development to enhance market returns. Farming systems and marketing research will be undertaken to underpin the strategy. This will include analysis of activities in trade liberalisation, policy and constraints; and of new opportunities and markets. The program also has a strong emphasis on building research and development capacity within the region.

3.2 Key performance indicators (2008–09)

- research program implemented that underpins emerging high-value forestry plantation programs for teak, whitewood and sandalwood
- projects developing new fruit crop opportunities for Tonga and new vegetable opportunities for Solomon Islands implemented
- improvements in aquaculture-based livelihoods investigated through a mini-project approach in at least three countries
- ACIAR–USP scholarship scheme implemented with at least five students placed within active ACIAR projects
- preliminary policy environment implications ready for adoption from an assessment of all ACIAR projects in the Pacific
- 40% of new projects designed to have significant farmer or policymaker impacts within 5 years of completion

3.3 Position

ACIAR's position in the Pacific islands will continue to develop in line with broader Australian development assistance priorities. There is an increasing awareness of the importance of changing economic and environmental situations, and the vulnerability of small developing island states if flexibility and adaptation to change are not achieved. The Pacific islands countries have a range of challenges including eroding tariff preferences, population and urban growth, migration of skilled labour, resource depletion and degradation, and risks from climate change. As described in Pacific 2020—challenges and opportunities for growth (www.aid.gov.au/publications/pdf/pacific2020.pdf), ineffective policy implementation is seen as a significant impediment to development and progress.

Agriculture, forestry and fisheries sustain many households and will comprise the majority of livelihoods of Pacific islands countries for the foreseeable future. Many smallholders live in isolated rural communities dependent on household food production and intermittent

crop, fish and small livestock sales. Improving and transforming these systems into sustainable income-generating activities through improved productivity and marketing will enhance self-reliance and reduce poverty over time, as will diversification into new activities.

The development of an agriculture-enabling environment is an ongoing objective. Participation in regional projects that address common problems, where appropriate, will help overcome the limited capacity of many countries to engage in collaborative activities. ACIAR has a strong emphasis on working with Pacific regional organisations to improve effective delivery of outputs. In partnership with the University of the South Pacific, ACIAR will implement a scholarships program designed to increase capacity in the region through the allocation of Postgraduate Diploma and Masters Degree scholarships for research associated with ACIAR projects in the Pacific.

3.4 Relationship to the AusAID regional strategy

AusAID's Pacific Regional Aid Strategy 2004–09 identifies four key themes: stronger broad-based growth; more effective, accountable and democratic government; improved law, justice and security; and enhanced service delivery. These themes are further underlined in the Pacific 2020 report with a commitment to address governance and institutions, infrastructure, regional cooperation and implementation of programs.

ACIAR's Pacific program, through its three research emphases (increased productivity

and diversification through new crops, products and value-adding; development of sustainable management systems; underpinning of systems development, economics, marketing and biosecurity), contributes to these objectives primarily in the thematic area of broad-based economic growth. In fisheries, ACIAR will work in cooperation with AusAID's new Pacific fisheries strategy developed in 2007.

3.5 Research priorities

Priorities for ACIAR – Pacific islands country cooperation are continually reviewed and updated in regular consultation with relevant government, community and private sector stakeholders. ACIAR also attends the regular regional priority-setting meetings of Pacific government agriculture, forestry and fisheries agencies, including the Regional Conference of Heads of Agriculture and Forestry Services meetings.

New projects will be considered in the areas of agriculture, forestry and fisheries under the following three thematic programs.

Subprogram 1: Improving household incomes and food security through more productive and diverse farming systems

- Integration of existing knowledge into information packages for fruit and vegetable crops
- Development and adoption of integrated production management packages for fruit, vegetable and plantation crops
- Identification, development and adoption of new market-driven opportunities for horticultural crops
- Use of locally available materials to develop cost-effective feed formulations for pigs, poultry and aquaculture species

Subprogram 2: Sustainable use and management of forestry and fishery resources

- Sustainable use of the region's valuable fisheries resources, with an emphasis on increased community participation and co-management of inshore fisheries
- Stock status assessment and planning for the sustainable use of vulnerable inshore fisheries, with an emphasis on increased community-level management and co management
- Introduction of new opportunities for inland aquaculture, including the domestication of promising indigenous species and integration into existing farming systems
- Valuation of resources and economic analysis of smallholder and commercial fisheries
- Domestication of multipurpose trees for forestry and agroforestry, including selection of suitable germplasm and silvicultural management
- Value-adding processing of forest products
- Sustainable management (and protection from pests and diseases) of high-value plantations and native forests

Subprogram 3: Farming systems economics, marketing and biosecurity

- Improvement in agricultural statistics recording to develop indicators that measure smallholder contribution to national economies
- Use of marketing research to help producers and industry identify market opportunities for agricultural commodities
- Economic analysis of returns and certification issues of current and potential crops or commodities
- Facilitation of adoption of earlier research on pest, weed and disease management
- Identification of quarantine and pest risk issues for crop germplasm requiring exchange between countries
- Development and adoption of quarantine pest and disease control measures for crop exports
- Undertaking of regional studies of import risks associated with the movement of live aquatic organisms, and definition of appropriate quarantine strategies

4 Active projects in the Pacific Islands

4.1 Subprogram 1: Improving household incomes and food security through more productive and diverse farming systems

This subprogram has two emphases. First, it aims to develop and implement strategies to underpin sustainable production and improved quality with a particular emphasis on management of crop pests and diseases. The second emphasis is market-driven diversification of production through exploitation of new market niches, genetic diversity, new products and value-adding. Many of these projects focus on the integration and adoption of results from previous adaptive research. The focal industry is horticulture, with a particular emphasis on vegetables and root crops. Some targeted activities in Solomon Islands and Tonga complement earlier successful work in Papua New Guinea on the use of local feeds for poultry and pig production.

Projects:

Project number	Project title	Page
LPS/2003/054	Feeding village poultry in Solomon Islands	13
LPS/2006/149	Feed for poultry and pigs in Tonga	15
PC/2003/046	Integrated control of powdery mildew and other disease, weed and insect problems in squash in Tonga and Australia	17
PC/2003/047	Improved plant protection in Solomon Islands	19
PC/2004/030	Control of Asian honeybees in Solomon Islands	21
PC/2004/049	Improved farming systems for managing soilborne pathogens of ginger in Fiji and Australia	23
PC/2004/063	Integrated pest management in a sustainable production system for Brassica crops in Fiji and Samoa	25
PC/2004/064	Biological control of 'mile-a-minute' (<i>Mikania micrantha</i>) in PNG and Fiji	27
PC/2005/077 (multilateral)	Integrated crop management package for sustainable home gardens in Solomon Islands (AVRDC)	29
PC/2005/134 (multilateral)	The use of pathogen-tested planting materials to improve sustainable sweet potato production in Solomon Islands and Papua New Guinea (CIP)	31
PC/2006/053	Evaluation of the effects of dasheen mosaic virus on taro yield (Fiji, Samoa)	33
PC/2006/106	Screening and field trials of high-carotenoid sweet potatoes for improving the vitamin A status of residents of Solomon Islands and Papua New Guinea	35
PC/2006/109	The potential for increasing the value of cocoa industries in Solomon Islands, Vanuatu, Fiji and Samoa	37
PC/2006/173	Sustainable tropical fruit production in Tonga	38

LPS/2003/054: Feeding village poultry in the Solomon Islands

Summary

Village poultry are a vital source of food security and, in many cases, supplemental income for smallholder farmers. In Solomon Islands an estimated 22,000 families have poultry, producing 210,000 birds and 2.64 million eggs a year. Both live birds and eggs are sold, usually in local markets. Poultry production by village families has considerable scope for improvement. Only one bird is consumed on average each month along with some eggs, with this likely to vary given other enterprises and income streams. An average of 30 per cent of infants are underweight with malnutrition the cause, despite an available source of protein and nutrition through eggs and birds. Two main barriers exist to increased production: better feeds and the size of the average family's flock.

Kastom Gaden Association (KGA), a local NGO, estimates that between 20 and 40 chickens per family would allow eggs to be eaten and sold each day as well as a regular consumption of chicken meat. Existing feeding systems, however, limit the number of chickens that can be run. This is despite a wide variety of local feed resources being available, including root crops, fruit and native plants. Identifying feeds for village chickens that would result in a higher nutritional intake and more cost effective poultry systems will produce more birds and eggs. This will boost income and begin to change the current system, ensuring more chickens are run and families see greater financial and dietary returns.

The project is developing improved systems of village-based poultry production, through:

- identifying rations for village-based layer and meat birds based on locally available feedstuffs
- interacting with farmers and farmer groups to evaluate, disseminate and communicate the value of rations based on local feedstuffs.

Project Information

Overseas Collaborating Countries:
Solomon Islands

Commissioned Organisation: South Australian Research and Development Institute, Pig and Poultry Production Institute, Australia

Project Leader:

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

Collaborating Institutions:

- Kastom Gaden Association, Solomon Islands
- Department of Agriculture and Livestock, Solomon Islands
- National Agricultural Research Institute, Papua New Guinea
- Solomon Islands College of Higher Education, Solomon Islands

Project Budget: \$523,159

Project Duration: 01/01/2005 to 31/10/2008 (Project extended from 01/01/2008 to 31/10/2008)

ACIAR Research Program Manager: Dr Debbie Templeton

Project progress

Year 3 (01/01/2007-31/05/2008)

In the Solomon Islands approximately 21,000 families (about 40% of the rural population) produce eggs and live village hens selling them in local markets. The sale of chickens is one of the major sources of income from the livestock sector of traditional smallholder farming systems. Birds are fed household food scraps and other locally available feedstuffs. There is a wide variety of local feed resources available that could be utilized more effectively such as root crops, fruit, forages, bush plants and vines. Farmers in the rural areas are introducing new crops with higher nutritional value for poultry such as sorghum, mung bean and pigeon pea. This project has established the infrastructure and capability in the Solomon Island to test and identify effective rations for village birds based on the wide variety of potential

Subprogram 1: Improving household incomes and food security through more productive and diverse farming systems

feeds and has developed the skills of staff to educate farmers on poultry feeding management.

Earlier in the project a poultry research facility was established at the Solomon Islands College of Higher Education (SICHE) in collaboration with Department of Agriculture and Lands (DAL) and Kastom Gaden Association (KGA). During the reporting period three experiments with village hens were conducted at the facility, feeding diets using local feed resources. The diets included various combinations of sorghum, pigeon pea grain and leaves, fresh coconut and cassava, paw paw fruit and leaves, corn, mung beans and fish meal. The trials compared the performance of birds fed the local home mix layer ration (formulated to NRC requirements) with an imported commercial layer feed. Corn and mung beans were included as whole grain in the rations. Cassava and pawpaw were chopped, weighed, mixed and fed fresh twice daily. Egg production, body weight and egg weight were lower in birds fed the local mix ration compared to the commercial ration. However the cost of imported feed was 5 times greater than the cost of growing local feed resources at SICHE.

KGA conducted farmer workshops on improved poultry feeding and management with over 100 village participants in Malaita and Western Province during the reporting period. KGA also hosted 30 farmer attachment programs (1-6 months duration) at the Burns Creek poultry extension facility during the project. The farmers learn how to feed, house and care for village poultry. The KGA attachment program is generating good results with the majority of students putting into practice the feeding and management skills learnt. Farmers from Turusuala have set up the improved feeding and management model on the remote weather (?) coast of Guadalcanal. A number of villagers have returned to the village, built a raised floor poultry house and fed the bird's pawpaw, coconut, sweet potato and cassava. Some farms have planted crops of cow peas, beans and sorghum to feed to the chickens. This activity has generated interest from other farmers.

Work is underway on preparing laminated one-page information leaflets on best practice feeding methods for village poultry. The leaflets show pictures of the feed ingredients, how they are prepared and fed to birds. The KGA poultry trainer's handbook and farmers booklet is being updated to include information generated from the project for distribution through the KGA village farmer network.

Prior to this project, the Solomon's village hen sector of the chicken industry had been largely overlooked for R&D&E support. This project has already improved the productivity on farms where villagers have been trained. Further encouragement of these activities would have a significant impact on national production and well-being of the rural communities. There is a high demand for village chickens in urban, peri urban and village communities in the Solomon Islands. This could be met by establishing commercial, semi-commercial and village scale poultry breeding units. In addition, use of local feeds in village hen poultry rations could be stimulated by establishing semi-commercial and village-scale mini feed mills to supply local feeds to village chicken farmers.

LPS/2006/149: Using local feeds to reduce the cost of pig and poultry production in Tonga

Summary

The major restraints for the development of a commercial pig and poultry sector in Tonga are the lack of a local feed manufacturing industry, the high cost of imported feed, and cheap meat and egg imports. This has resulted in a reduction in the number of pig and poultry producers over recent years, despite the adequate local supplies of cassava, sweet potato, fresh coconut and maize, which could form the basis of the feed industry.

The project will provide training for Tongan government staff and key producers about profitable pig and poultry feeding systems developed in current ACIAR pig and poultry projects in Indonesia, PNG and the Solomon Islands. They will learn to operate mini mills and receive instruction on how to feed pig and poultry using concentrates, ration dilution and whole ration formulation using local feed resources. Feeding systems suitable for Tonga will be demonstrated on-station at the Livestock Division of the Ministry of Agriculture, Food, Forests & Fisheries and Tupou College to farmers and students.

The proposal was developed following a request from the Prime Minister of Tonga for assistance in developing a local feed industry for pigs and poultry.

Project Information

Overseas Collaborating Countries: Tonga

Commissioned Organisation: South Australian Research and Development Institute, Australia

Project Leader:

Dr Phil Glatz

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Collaborating Institutions:

- Ministry of Agriculture, Food, Forestry and Fisheries, Tonga
- Ministry of Community, Employment, Youth and Sports, Tonga
- Tupou College, Tonga

Project Budget: \$110,736

Project Duration: 01/05/2007 to 31/10/2008

ACIAR Research Program Manager: Dr Debbie Templeton

Project progress

Year 1 (01/05/2007-31/05/2008)

Livestock production is an important economic activity in Tonga with 80% of households keeping livestock. The pig and poultry industries are an important part of social life with nearly 80% pigs and just over 50% of poultry produced being used to meet community social obligations. Retail prices are comparable with Australia and the sale of live sucker and weaner pigs for feasts accounts for 90% of the pig market. The major issues restraining the development of a commercial pig and poultry sector are the lack of a local feed manufacturing industry, the high cost of imported feed and the importation of relatively cheap pig and poultry meat, mainly coming from Australia, New Zealand and Canada. This has resulted in a reduction in the number of pig and poultry producers over recent years.

This project aims to establish a local feed manufacturing industry to revitalise the Tongan pig and poultry industries. The strategy being used is to train Tongan government staff and key producers about profitable pig and poultry feeding systems using approaches developed in other South Pacific countries and in Indonesia to implement in Tonga.

Three livestock farmers and a government scientist undertook a study tour to the Solomon Islands and Papua New Guinea from 10-20 August, 2007. They spent two days in the Solomon Island and five days in PNG and met with local R&D staff and NGO's and learnt about the operation of mini-mills and received instruction on how to feed pig and poultry using concentrates, ration dilution and whole ration formulation using local feed resources.

Following the study tour all the project partners met in Tonga from 17-20 October 2007 and agreed to demonstrate suitable feeding systems for pigs and poultry in Tonga based on examples observed in PNG and Solomon Islands. A mini mill was

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purchased from PNG and shipped to Tonga in April 2008 for establishment at Tonga's Ministry of Agriculture, Food, Forests & Fisheries (MAFFF) research centre. Feeding trials with pigs and poultry to demonstrate the most profitable feeding systems that incorporate local feeds will be run at MAFFF's research centre prior to wide-spread dissemination across the Tongan pig and poultry industry. The other Tongan agencies supporting the initiative are the Ministry of Training, Employment, Youth and Sport (MOTTEYS) which run an Agriculture Diploma Program and Tupou College which trains high school students in pig and poultry production.

The use of cheaper local feed in the alternative feeding systems could lead to an expansion of the smallholder egg and chicken meat and pork sectors, with these farmers making a significant contribution to the meat requirements of the country. If 10% of local feed could be used in pig and poultry rations to replace the imported feed, this would save Tonga an estimated TOP\$5.75m/annum in imports.

PC/2003/046: Integrated control of powdery mildew and other disease, weed and insect problems in squash in Tonga and Australia

Summary

Agriculture is a vital contributor to the economy of Tonga. It is the leading employer, foreign exchange earner and is essential to food security. The leading agricultural export is squash, earning \$10.8 million in 2002. Squash is quick and easy to grow with a clear market in exports to Japan. In recent times other export industries in the agriculture sector have suffered due to pest and disease problems, making squash even more vital. These disease and pest problems are now beginning to reach threatening levels in the squash sector too. Controls against pests and diseases have been less effective. In turn this has increased pesticide usage resulting in pesticide resistance emerging. The use of pesticides also has implications for Tonga's water supply which is particularly vulnerable to water borne pollutants. The prevalence of diseases and pests has reduced the industry by close to two-thirds, from 2000 active farmers in 1987 to an estimated 550 in 2003.

Powdery mildew is the main disease. Outbreaks defoliate crops, in turn making plants more vulnerable to silver leaf white fly, other viruses and weeds. Current fungicides against powdery mildew are unreliable with increasing resistance reported. Past ACIAR research has demonstrated the value of integrated approaches to controlling powdery mildew which are applicable to Tongan conditions. These, along with pest controls targeting white fly and disease controls against viruses found in squash, have the potential to significantly rehabilitate the industry. The sustainability of the Tongan squash industry is being addressed through improvements to integrated disease, pest and weed management, specifically to improve field-based crop protection and market quality of squash within a systems framework. Foster the sustainability of the Tonga squash industry through improvements to integrated disease, pest and weed management, specifically to improve field-based crop protection and market quality of squash within a systems framework addressing:

- powdery mildew
- silverleaf whitefly
- virus management
- weed management
- grower uptake and market implications.

Project Information

Overseas Collaborating Countries: Fiji, Tonga

Commissioned Organisation: University of Sydney, Faculty of Agriculture Food and Natural Resources, Australia

Project Leader:

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Collaborating Institutions:

- Ministry of Agriculture, Forestry and Food, Tonga
- Secretariat of the Pacific Community, Fiji

Project Budget: \$486,192

Project Duration: 01/01/2005 to 30/09/2008 (Project extended from 01/07/2008 to 30/09/2008)

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 3 (01/01/2007-31/05/2008)

Under the leadership of Dr Viliami Manu, Head of Vaini Research Station, the Tongan MAFF research team made significant progress in meeting objectives in 2007. The 2007 field trial for controlling powdery mildew on squash using fungicides suggests there is no resistance to currently available fungicides in Tonga. Rotational use of the fungicides is important to prevent resistance development in powdery mildew strains.

The GRAS chemicals tested in Tonga and Australia show consistent effectiveness for the control of powdery mildew of squash. A recommendation will be made on the cost to the Tongan and Australian markets on incorporating GRAS chemicals into the spray schedule, reducing the reliance on fungicides.

A study on the powdery mildew populations in squash in Tonga is underway by Ms Tupouniua as part of her PhD study program. Samples of squash powdery mildew are being tested for their sensitivity against different fungicides along with a

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microscopic study for taxonomic identification.

Field evaluation of insecticides to control Silverleaf Whitefly was not conclusive because of very low infestation in squash during the experimental season (August 2007). An experiment on biological control of Silverleaf Whitefly in tomato is underway in controlled conditions with the introduced parasite of *Eretmocerus hayati* from Brisbane CSIRO. Methods for screening alternative hosts of viruses affecting squash production were demonstrated to MAFF personnel and the tests are being conducted.

The experiments for the effectiveness of the cover crop of *Macuna pruriens* that began in 2006 and again in 2007 has been shown to be beneficial in controlling weed population as well increasing economic returns from squash cultivation.

A survey was conducted in 2007 in squash growing areas for prevalence of insect pest and diseases and weed infestation. Good rainfall and a cool climate in 2007 resulted in increased production of squash, through increased fruit set, despite significant powdery mildew infestation during the season. The same climatic conditions reduced the population of Silverleaf Whitefly, and as a result, lowered the level of infection by virus.

PC/2003/047: Improved plant protection in the Solomon Islands

Summary

Food security in many areas of the Solomon Islands is built on subsistence agriculture. Root crops are the staple foods, along with fruit and nut species and leaf and other vegetables. Agricultural production involves more than 80 per cent of the population, with women the main food producers. Surpluses of food, when produced, are usually sold to meet household expenses. One of the major problems faced by most smallholder farmers is pests. Another is diseases attacking crops. For pests the main controls are pesticides, but these are expensive. Buying pesticides means foregoing income that could be spent elsewhere, especially on household needs. Pest and disease problems are particularly prevalent in rural areas with high population densities.

Exacerbating these problems is the breakdown and loss of infrastructure reflecting the broader declines in infrastructure during the civil unrest and tensions of recent years. The main Department of Agriculture and Livestock research complex was destroyed by fire in 2000 and the remaining facilities lack resources.

With both the farming and research community lacking resources to address pest and disease management the project is rebuilding these areas by:

- developing integrated pest management (IPM) strategies for major food crops
- increasing government staff and community awareness and understanding of plant pests and diseases, leading to improved and sustainable crop management.

Project Information

Overseas Collaborating Countries: Solomon Islands

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader:

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Project Web Site: <<http://www.pestnet.org/>>

Collaborating Institutions:

- Kastom Gaden Association, Solomon Islands

- Vois Blong Mere Solomon, Solomon Islands
- Department of Agriculture and Livestock, Solomon Islands

Project Budget: \$471,689

Project Duration: 01/01/2005 to 31/03/2010 (Project extended from 01/01/2008 to 31/03/2010)

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 3 (01/01/2007-31/05/2008)

Following slow progress in the first and second years, a workshop on developing collaboration between the partners was held in February 2007, the outcome of which was an IPPSI Partnership Agreement, signed in June 2007 by the Ministry of Agriculture and Livestock, Kastom Gaden Association and Vois Blong Mere Solomon as country partners, and the Secretariat of the Pacific Community and TerraCircle Inc., as commissioned organisations. In addition, and to help develop momentum, TerraCircle was contracted by ACIAR in June 2007 to spend greater time on the project – one day a month – and to make quarterly visits to help plan activities.

Strengthening the crop protection capability of MAL is a major aim of IPPSI and towards this goal there has been progress. The entomology lab is functional and shared with livestock. Plant pathology equipment has been received and a lab is in the process of being established at SIDT. Research on Nisotra by the senior entomologist for a higher degree has continued at the University of Queensland, and so has distribution of Derris as a source of rotenone against it, but the studies on Riptortus have stopped due to lack of staff to do the work – although a flyer on management options has been published - and the Encarsia parasitoid of white peach scale has yet to be introduced because of the difficulty in establishing a lab culture. SPC has agreed to give fruit fly control training, allowing IPPSI to delete this from its work program.

An insect collection has been started by an Australian Volunteers International (AVI), photos of pests have been placed online,

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and a lab technician trained to continue the work, although more training in curating and identifying insects is required. The AVI left in December 2007 and was not replaced, nor has the second lab technician been recruited.

Two consultants visited to assist the research on Nisotra, one from the University of Queensland (Dr Mike Furlong) and the other from the Australian Museum. During the visit, Mike Furlong showed the lab technician how to survey for natural enemies of Diamond back moth, and Chris Reid commented on the lab, the insect collection and taxonomy needs and how improvements might be made.

The project has continued to import elite food crop germplasm from the SPC CePACT; this has been distributed successfully to farmers through KGA networks.

Training in crop protection is a major part of IPPSI. KGA has organised training in organic vegetable production using a farmer-field-school approach and these 6-week workshops have been popular. KGA has also contracted a lead farmer to deliver training in the management of *Alomae* in the highlands of Malaita to good effect. There has also been progress in the development of a crop protection curriculum, adapting a module used in Tonga. There is now a clear strategy for this trainer of trainer program: a core group of trainers will use the curriculum – written by a member of SICHE – to train extension staff of government and non-government organisations, who in turn will train members of the community. The training will be the priority of future activities.

A review of the project was carried out by ACIAR and the partners, MAL, KGA and VBMS in April 2008. It was recommended that the project would be extended for 18 months and that ACIAR would contribute a further \$150,000.

PC/2004/030: Control of Asian honeybees in the Solomon Islands

Summary

This project addresses a problem that can be traced to the 1970s with the introduction of the Asian hive bee (*Apis cerana*) into New Guinea from Java. The bee subsequently became invasive, spreading throughout the entire Island of New Guinea (Indonesian Papua and PNG) to the offshore islands of Biak, Yapen, and New Britain, and to Boigu, Saibai and Dauan Islands in Torres Strait. Spreading swarms of the bee are now regularly intercepted on vessels arriving at Australian ports from New Guinea, the latest being intercepted in April 2005. In March 2003, *A. cerana* was discovered 1200 km east of New Guinea on Guadalcanal and Savo Islands in the Solomon Islands.

Since the arrival of *A. cerana* in Solomon Islands there has been a loss of European honeybee colonies (*Apis mellifera*) and consequent decline in honey production. An assessment of the incursion in April 2004 by CSIRO determined that the Asian bee had become established, could not be eradicated and would eventually spread to other Islands. DNA fingerprinting showed that the bee had most likely arrived from New Guinea. It was also carrying a strain of *Varroa* mite but this was harmless to *A. mellifera*. The assessors attributed the honey declines and losses to the inability of *A. mellifera* to compete with *A. cerana* for food (nectar and pollen).

Solomon Island Government officials, local bee farmers and other stakeholders met in Honiara in 2004 and agreed unanimously that the honey industry based on *A. mellifera* should be saved. Recommendations from that meeting form the basis of this project.

Project objectives are to:

- develop and implement a method for suppressing feral *A. cerana* populations on Guadalcanal and Savo Islands
- develop and implement a surveillance system for the early detection of *A. cerana* in the Solomon Islands
- determine the pest and disease status of *A. cerana* and *A. mellifera* in the Solomon Islands
- obtain information on the varroa mite reproduction system.

Project Information

Overseas Collaborating Countries:
Solomon Islands

Commissioned Organisation: CSIRO Entomology, Australia

Project Leader:

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Collaborating Institutions:

- Department of Agriculture and Livestock, Solomon Islands
- NSW Department of Primary Industries, Australia
- Honey Producers' Cooperative Association, Solomon Islands

Project Budget: \$342,398

Project Duration: 01/04/2007 to 31/03/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 1 (01/04/2007-31/05/2008)

This project addresses a decline in honey production and loss of European honeybee colonies (*Apis mellifera*) in the Solomon Islands since the arrival of the Asian honeybee (*Apis cerana*). Research is aimed at reversing these declines by developing methods that, when implemented, will suppress the Asian honeybee populations. This, in turn, will increase the foraging competitiveness of the European honeybees and restore hive numbers. Other project research will develop and implement surveillance systems for Asian honeybees on islands currently free of the bee and determine the pest and disease status of both Asian and European honeybees throughout the Solomon Islands.

Since their initial detection in the Solomon Islands in 2003, Asian honeybees have spread to approximately half of the large Islands. Sea shipping and commercial logging operations have facilitated this spread. In some cases swarms of bees

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have been able to fly between islands that are close together. The arrival of the bees on Guadalcanal has resulted in a decline of hived European honeybee colonies from approximately 2000 hives in 2000 to five in 2008. This decline appears to have been a result of the newly arrived bees out-competing the European honeybees for floral resources, as well as robbing. Extension activities carried out in this project over the past year have led to the introduction of surveillance for Asian honeybees on Malaita Island, one of the last large beekeeping islands still free of the bees.

Trials aimed at suppressing Asian honeybees are now being conducted on Savo Island, as it contains no European honeybees. Approval to conduct the trials was obtained from leaders of the local community. Initially, different lures are being tested for their ability to attract forager Asian honeybees to bait stations containing a sugar reward. Once a suitable lure is identified and optimised, an insecticide will be added to it that the foraging bees will carry back to their parent colonies. The effectiveness of the insecticide in suppressing the island population of Asian honeybees will then be gauged. During the past year, 4 different lures were tested for their ability to attract forager Asian honeybees. The most effective and cheapest lure tested was a flat open dish, that initially contained fresh honey and honeycomb collected from a feral Asian honeybee colony, but which was subsequently replaced with 60% sugar syrup. When offered during early morning (before 9.00am) this lure attracted no non-target insects. The addition of an Asian honeybee swarming pheromone to the lure did not improve its attractiveness. However, early results indicate that low concentrations of eicosanol (0.1mg or less) may improve the attractiveness of the lure, as may the addition of an *A. cerana* footprint pheromone and odors extracted from coconut flower.

As part of activities aimed at determining the health status of honeybees in the Solomon Islands, two viruses were isolated from samples of dead adult Asian honeybees. Isolates of varroa mites, collected from both *A. cerana* and *A. mellifera* brood throughout the Solomons, were also identified by DNA fingerprinting as the Java strain of *Varroa jacobsoni*. Reproduction by these mites was only observed on drone brood of *A. cerana*.

PC/2004/049: Improved farming systems for managing soil-borne pathogens of ginger in Fiji and Australia

Summary

Ginger farming is inundated with problems related to increasing soil-borne pathogens. Fiji and Australia have been affected severely in recent years with declining crop yields and poor rhizome quality.

Edible ginger (*Zingiber officinale*) is grown as an annual crop in Fiji and Australia with harvests coinciding with market and factory demand. 'Seed-pieces' are also harvested and used for planting next season's crop. A major constraint to production in Fiji is the soil-borne pathogen *Pythium myriotylum*, which infects seed-pieces and causes rot and early death in plants. In Australia the major soil-borne pathogen of edible ginger is *Fusarium oxysporum* f. sp. *Zingiberi* that is also responsible for extensive rhizome rots. Annual farm-gate losses due to soil-borne pathogens are currently estimated at FJ\$530 000 for Fiji and AU\$990 000 for Australia with the situation deteriorating.

The major focus of this project is to find farming systems that can restore the chemical, physical, and biological fertility of the soil. Reducing inoculum density and managing resident microbial antagonists that modulate the state of disease suppression in soils may be achieved by various rotational practices, as well as through the use of mulches and organic amendments. The introduction of a minimum tillage system for mechanised ginger production systems is a novel approach that warrants testing because of its role in conserving organic matter. It has not been investigated before and builds on the success of minimum tillage in other industries. Due to differences in key pathogens; soils, climate and level of mechanisation; the farming systems that are feasible in Australia and Fiji will differ. In both cases, farming systems will be built on well-established principals of creating good soil health. Practices such as biofumigation and plant defence activators such as silicon will be included within the farming system. Treatments will be evaluated by measuring a range of standard soil physical, chemical and biological properties and by measuring the effects of treatments on yield losses due to nematodes and soil-borne pathogens.

Clean seed trial blocks will be established to promote and demonstrate the value of clean planting material in managing soil-borne pests and diseases. There is an urgent need to

break the 'diseased plant – diseased seed – diseased plant' cycle.

The overall aim of the project is to improve profitability and yield quality of ginger in Fiji and Australia through better management of soil-borne diseases.

Project Information

Overseas Collaborating Countries: Fiji

Commissioned Organisation:
Queensland Department of Primary Industries and Fisheries, Queensland Horticulture Institute, Australia

Project Leader:

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Collaborating Institutions:

- Biological Crop Protection, Australia
- Buderim Ginger Ltd, Australia
- Secretariat of the Pacific Community, Fiji
- Ministry of Agriculture, Sugar and Land Resettlement, Fiji

Project Budget: \$617,974

Project Duration: 01/01/2006 to 31/12/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 2 (01/01/2007-31/05/2008)

After conducting disease and pest surveys in Fiji during the first phase of the project, studies are currently concentrating on the two most serious soil-borne pathogens of ginger in Fiji, *Pythium* and *Radopholus*. The 2006-07 and 2007-08 ginger growing seasons were characterised by fluctuating weather conditions where heavy rainfall events were followed by dry conditions. For instance on December 18 2006 Suva established its highest one-day rainfall record (272 mm) but was followed by its driest January on record. Again, above average rainfall was recorded during January 2008, but was followed by two drier than average months with March 2008 being the driest on record. Under these

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conditions *Pythium* on ginger does not reach epidemic proportions and our surveys conducted over the reporting period found low levels of infection on ginger harvested for the immature market. The low incidence of *Pythium* also confounded field experiments established during this period.

However the summer of 2007-08 in the ginger growing area of Australia was one of the coolest and wettest for many years; similar La Niña events were recorded for the 1974-75 and 1975-76 summers. Crops were in excellent condition in early December but higher than normal rainfall and long periods of cool, overcast conditions over the next two months left the soils saturated and *Pythium* spread very rapidly on some farms. Fields were totally destroyed or severely affected and Australia's immature ginger harvest was reduced by 15%.

Pythium has been isolated from ginger in both Fiji and Australia and found to be highly pathogenic in glasshouse tests. The Australian isolate has been identified as *P. myriotylum* and the Fijian isolates are currently held in quarantine at the University of Queensland and will be identified later this year. In laboratory tests conducted at Koronivia Research Station both high temperature (capable of growth up to 38°C) and low temperature (grew at 25°C, but not at 35°C) isolates were recovered and of the high temperature isolates, KRS14 damaged plants more quickly and more severely than KRS17. High temperature isolates of *Pythium* are likely to be *P. myriotylum* and/or *P. aphanidermatum*. Glasshouse experiments showed that neither *Radopholus* nor *Meloidygyne* need to be present to cause damage to ginger roots or rhizome before *Pythium* infection occurred.

Further studies with *Radopholus* in Fiji have demonstrated that nematode damage is minimal in the immature ginger crop but can be devastating when ginger is being carried over for seed. On one farm in the Veikoba district, seed ginger losses of 70% were recorded in one field. The numbers of nematodes on rhizomes varied considerably but were extremely high in some cases (5,200 *Radopholus* extracted from a 25 g piece of rhizome). Furthermore *Radopholus* populations are being maintained during crop rotations on volunteer ginger and also on common weeds such as crow's foot (*Eluesine indica*). Results from field and glasshouse studies have shown that when nematode-

infested seed is planted, *Radopholus* can multiply to relatively high population densities within a few months. Likewise nematode-free seed when planted in infested soils is readily susceptible to infection.

Growers and exporters recognise that lack of good quality seed for planting material is a major problem with the spread of soil-borne pathogens. A recent industry survey has also shown that hot-water treatment equipment provided by the extension service is seldom used and even when hot-water treatment of seed is practiced, it is being done incorrectly and at temperatures that are insufficient to kill nematodes.

Strategies to control soil-borne pathogens of ginger are under investigation. We believe central to control of nematodes, *Pythium* and *Fusarium* is increasing soil microbial activity and diversity, while improving soil nutrition, to create conditions that suppress pests and diseases of ginger. Preliminary results from Australian field and glasshouse experiments have shown that carbon inputs from plants and amendments improve the biological status of soils while excessive tillage and fallowing have a negative impact. Suppressiveness to root-knot nematode, and to a lesser extent *Fusarium*, was enhanced by amending soil with poultry manure/sawdust, and by reducing tillage. Research into control strategies continues.

Finally two project staff from Fiji have undertaken training activities in Australia. The project's pathologist has undertaken studies for a Master of Plant Protection from the University of Queensland with support from a John Allwright Fellowship during 2007-08. The project's nematologist completed a training program in practical nematology with Biological Crop Protection in 2007 and plans to undertake further studies. Results have been communicated at grower field days and will be presented at two international scientific symposia later in the year.

PC/2004/063: Integrated pest management in a sustainable production system for Brassica crops in Fiji and Samoa

Summary

In the Pacific islands both large landholders and smallholder farmers grow brassicas - mainly head cabbage, Chinese cabbage and watercress. The production of these crops has increased dramatically in Fiji and Samoa, where Chinese cabbage is rapidly becoming the major source of green leaf vegetable. But producers must combat diamondback moth, the leading pest of brassica crops. With brassica production increasing in recent years, opportunities have increased for the moth to spread, and insecticides have been the main forms of control.

Integrated pest management (IPM) approaches that limit insecticide use while maintaining control of diamondback moth have been used elsewhere in the world. Pacific islanders need an IPM program with local relevance. But successful IPM programs developed in Southeast Asia cannot simply be transferred to Fiji and Samoa, due to regional differences in behaviour between the pest complexes, inadequate knowledge of the structure and function of local natural enemy assemblages and important differences in climate.

This project is designed to increase knowledge of the moth and to develop appropriate IPM packages for each collaborating country. Its main objective is to facilitate the adoption and uptake of IPM as a component of sustainable agricultural management systems for brassica crops in partner countries. It is seeking to determine the composition and efficacy of the natural enemy pest complexes of brassica insect pests in Fiji and Samoa, and how to integrate this natural resource with other pest control tactics to develop sustainable brassica crop protection programs.

Project Information

Overseas Collaborating Countries: Fiji, Samoa

Commissioned Organisation: University of Queensland, School of Integrative Biology, Australia

Project Leader:

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Collaborating Institutions:

- Secretariat of the Pacific Community, Fiji
- Ministry of Agriculture, Sugar and Land Resettlement, Fiji
- Ministry of Agriculture and Fisheries, Samoa
- Queensland Department of Primary Industries and Fisheries, Australia

Project Budget: \$686,541

Project Duration: 01/07/2005 to 30/06/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 3 (01/07/2007-31/05/2008)

Objective 1: To demonstrate effective integrated approaches to Brassica pest management

A trial conducted at Sigatoka research station tested a preliminary IPM strategy against current farmer practice and control (no intervention) treatments. The experiment showed that IPM effectively managed the pest complex (diamondback moth (DBM) and large cabbage moth (LCM)), promoted natural enemy activity and resulted in crop yields which were = yields achieved by farmer practice. A similar experiment was conducted at Nu'u crop research station in Samoa March-May 2008 but the data is yet to be received. A refined version of the preliminary IPM strategy will be tested in both Fiji and Samoa in the 2008 growing season.

Objective 2: The introduction of a FFS approach for improved sustainable production systems in Brassica crops and effective communication of project outputs

Following the FFS train the trainer activities (Samoa: May 21-31, 2007; Fiji: June 4- 15, 2007) reported on previously the master trainer revisited each FFS group shortly after its inception to help deal with any problems and provide additional support during the early stages of activities. The FFS groups in both countries were not sustained following the departure of the master trainer. The FFS train the trainer activities for 2008 have been postponed

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until July and August as inclement weather in Fiji has delayed the preparation of field training plots. The sustainability of FFS activities following the departure of overseas project team members will be specifically addressed in the forthcoming training activities. Project outputs were communicated by oral and poster presentations at the

Australia and New Zealand Biocontrol Conference, Sydney 10-14 February 2008. In 2007 a documentary explaining the aims and objectives of the project was broadcast on national television networks throughout the Pacific Island countries and territories. In December 2007 the project leader traveled to Solomon Islands and worked closely with entomologists involved in ACIAR project HORT/2003/047 to develop approaches to survey *Brassica* crops for pest insects and their natural enemies.

Objective 3: To determine the role of major natural enemies in the management of Brassica crop pests

Regional surveys have confirmed that the DBM parasitoids *Cotesia vestalis* and *Oomyzus sokolowskii* are widely established in the major *Brassica* crop growing areas of Viti Levu, Fiji. The surveys did not record any parasitoids of LCM. In September 2007 a large study to measure the impact of natural enemies on experimental populations of DBM was conducted at Sigatoka research station. The work showed that both *C. vestalis* and *O. sokolowskii* can be effective parasitoids of DBM in Fiji and that considerable pest mortality also occurs in cabbage crops due to the combined action of generalist predators (predominantly spiders and ants). In Samoa the establishment of *C. vestalis* and *O. sokolowskii* has been confirmed but no studies have yet measured their impact on pest populations (extremely low field populations of the pest have been recorded following its seasonal decline in the 2007 wet season). Regional surveys have recorded LCM egg masses attacked by *Trichogramma chilonis* at a number of sites on Upolo and preliminary studies to assess the impact of the egg parasitoid on its host indicate that it may have a significant role to play in an IPM programme.

Objective 4: To develop a refined local IPM strategy using selective plant protection products

Preliminary IPM programmes based initially on threshold directed intervention with foliar applications of *Bacillus thuringiensis* have been developed and tested. Initial studies indicate that DBM thresholds are appropriate but that LCM thresholds will need some revision, revised thresholds and a modified sampling plans will be tested in the 2008 field season. The efficacy of a range insecticides (Prevathon (rynaxphur), Steward (indoxacarb), Match (lufenuron), Delfin (*Bacillus thuringiensis* - kurstaki) and Xentari (*Bacillus thuringiensis*- aizawi) was tested against the insect pest complex of *Brassica* crops in a field experiment conducted at Sigatoka research station in the latter half of 2008. The performance of these compounds was compared to that of a synthetic pyrethroid (prophylactic application of which is currently standard practice for most farmers in both Fiji and Samoa). The selective insecticides performed better than the synthetic pyrethroid and the study indicated that both formulations of *Bacillus thuringiensis* are suitable for inclusion in IPM strategies against the *Brassica* pest complex in Fiji.

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

Summary

Papua New Guinea and Pacific Island Countries (PICs) are becoming increasingly concerned about the occurrence, spread and impact of weeds on the region's food crops (such as taro, sweet potatoes, yams, bananas, papaya and green vegetables) and cash crops (cocoa, vanilla, sugarcane, kava and oil palm). By affecting yields, some introduced weeds directly affect food security and income and impact on the natural ecosystem functions. However, most Pacific islands lack the technical capacity to prevent the introduction of serious weeds or manage them effectively. This project is tackling one of the Pacific's most important weeds (as ranked by the 2004 meeting of Pacific Heads of Plant Protection) - mile-a-minute (*Mikania micrantha*). Mikania is a major problem throughout the Pacific. Solomon Islands, Niue and Vanuatu have infestations, but it is particularly severe in PNG and Fiji.

In PNG, mikania is already one of the major weed invaders of farms in several provinces. It can form a dense ground cover, out-competing other ground species such as sweet potato and yams, or can grow up and over garden crops, such as taro, papaya and lowland coffee, completely smothering vegetation and causing loss of production and localised death of these crops. In plantations, mikania can grow up into the canopy of plantation trees, completely smothering them, interfering with harvesting of coconuts, oil palm or cocoa pods. The weed has also become a significant weed in young cocoa and vanilla plantations in East New Britain, and young oil palm plantation in West New Britain. In Fiji, mikania is a serious weed in mature taro and kava plantations and is one of the major weeds in sugarcane farms on both Viti Levu and Vanua Levu. In many areas, farmers cannot afford costs of manual or chemical weed control.

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

Project information

Overseas Collaborating Countries: Fiji, Papua New Guinea

Commissioned Organisation: Queensland Department of Primary Industries and Fisheries, Australia

Project Leader:

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Collaborating Institutions

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

Project Budget: \$579,018

Project Duration: 01/01/2006 to 30/06/2009 (Project extended from 01/01/2009 to 30/06/2009)

ACIAR Research Program Manager: Dr T K Lim

Project progress

Year 2 (01/01/2007-31/05/2008)

There has been steady progress on the project in some areas. However, there have been some obstacles encountered which have severely impacted on the project. There have been some changes to project staff with key personnel leaving. This has resulted in a reduction of momentum and capacity. Staff have now been appointed but some training is required. Most infrastructure work has now been completed. Quarantine upgrades have been conducted in Fiji and PNG. However, minor work is still required at NARI, Kerevat, and PNG before approval of the facility is granted. The approval for the importation and field release of the rust in PNG is dependent on the satisfactory upgrade of the quarantine. Shade houses

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have been constructed in WNB by PNGOPRA and at SPC in Fiji.

Growth studies have been conducted in Fiji and PNG, showing mikania can grow over 1 m per month. Impact studies have been completed in Fiji and in some parts of PNG. Communication problems with the regions have impacted on this activity. There is excellent data on the distribution of mikania in Fiji, with it being found on all major islands and affecting a wide range of land uses. There is good data on its distribution in PNG in two provinces but little is known of its distribution elsewhere.

Actinote spp. was imported into Fiji several times and host testing commenced. Unfortunately a culture could not be maintained. A decision to re-import will be made depending on whether approval is granted to import and field release the rust in Fiji. An application to import and field release *Actinote* spp. in PNG is being prepared.

Host testing of the rust *Puccinia spegazzinii* was completed by CABI Europe-UK under contract. The rust was host specific and an application to import the rust into quarantine at SPC, Fiji was approved. However, approval to field release the rust into Fiji has not been granted. Several workshops have been held and support from various groups has been received. It appears that Fiji Quarantine is not prepared to sign the approval at this stage. An application to import and field the rust in PNG has been submitted and approval is pending the satisfactory upgrade of the quarantine facility at NARI, Kerevat, and PNG.

Workshops involving project staff were not conducted due to logistical problems. However, meetings were held with project staff in Fiji and PNG to discuss project objectives, activities and responsibilities. Future meetings will need to be held to assist new staff with project activities.

PC/2005/077: Integrated crop management package for sustainable smallholder gardens in Solomon Islands

Summary

In Solomon Islands (SI) most islanders live in isolated rural communities dependent on subsistence and intermittent crop and small livestock sales. Vegetable gardens are sources of food and income for the rural and urban populations, yet the area cultivated to vegetables is small compared to major staple starchy crops. There are growing numbers of smallholder vegetable farms around Honiara and vegetable farming is also becoming important in the neighbouring islands of Malaita and Makira. But in spite of this encouraging trend, local production and supply fall short of meeting year-round domestic demands, and there is great potential to improve and increase vegetable production.

An earlier scoping study assessed the smallholder garden sector to identify major technical and socioeconomic constraints and to define opportunities for further development through R&D projects. The study found potential for increased smallholder vegetable production, but this potential was constrained by technical and socioeconomic factors that would significantly influence any move into vegetable production on a commercial scale.

The main objective of the project is to increase the economic status and potential income-generation opportunities for Solomon Islanders by addressing the major constraints to vegetable production through strategies that link to other related ACIAR-funded projects currently under way in Solomon Islands.

Project Information

Overseas Collaborating Countries: Solomon Islands

Commissioned Organisation: The World Vegetable Center, Taiwan

Project Leader:

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Collaborating Institutions:

- Ministry of Agriculture and Livestock, Solomon Islands
- Don Bosco Technical Institute Rural Training Center, Solomon Islands
- Kastom Gaden Association, Solomon Islands

- Farmset Limited, Papua New Guinea
- NSW Department of Primary Industries, Australia
- Vois Blong Mere Solomon, Solomon Islands

Project Budget: \$747,752

Project Duration: 01/05/2007 to 30/04/2011

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 1 (01/05/2007-31/05/2008)

The project commenced in May 2007 and the inception and planning workshop was held on July in Honiara which was participated by local project collaborators from the Ministry of Agriculture and Livestock (MAL), Kastom Gaden Association, (KGA) Don Bosco Rural Training Center (DBTC), Vois Blong Mere Solomon (VBMS) and Farmset Limited, Inc. The planning workshop was opened with remarks from Mr. Edward Kingmele, Permanent Secretary, Ministry of Agriculture and Livestock, Solomon Islands. The project partners reviewed the project document and discussed the various activities based on the four objectives. From the discussions, key activities were finalized for implementation. At the end of the workshop, project partners visited the facilities of MAL, KGA and Don Bosco.

The first major activity was a participatory rural appraisal (PRA) of the three provinces on October. The participatory assessment was conducted for selected village groups in Guadalcanal plains (Honiara), Malaita (Dala and Busurata) and Makira (Kirarkira) to understand and describe the current crop management practices and major production and socioeconomic constraints of smallholder vegetable farmers. Vegetable farming system in the three islands differed slightly in terms of crops, cropping system and level of crop management. However, farmers shared common problems and experienced similar technical and socioeconomic constraints. Farmers grow a variety of vegetable types, species and cultivars. Among the prominent vegetable crops are the leafy

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and fruit types, while root and tuber vegetables are also important since they constitute the traditional food crops. Two systems of vegetable cropping were observed in the three islands. In Guadalcanal and Malaita, continuous cropping with short fallow period is practiced. In Makira, the traditional slash and burn or shifting cultivation is common. Fallow period lasts from two to seven years in Makira, while in Malaita it depends on population pressure, but ranges from one to five years. The shortest fallow period (three months) was observed in Honiara plains, Guadalcanal.

In terms of crop management, Guadalcanal and Malaita farmers use production inputs such as fertilizers and agrochemicals. In contrast, farmers in Makira do not use any of the external/production inputs.

In all sites, pest and disease problems emerged as a major production constraint. Farmers in Malaita mentioned that fungal infection and insect damage are more prevalent after prolonged heavy rains followed by hot sunny days. In Guadalcanal, insect pest damage is predominant in the dry season while disease incidence is high during the wet season. Incidence of pests and diseases occurs all year-round in Makira, but higher in wet than dry season. In Makira, lack of improved seed, gardening tools and incidence of pests and diseases are the major constraints to higher productivity.

To address the major technical and socioeconomic constraints, project partners formulated recommendations that will be implemented into field activities. These include seed evaluation and variety assessment, simple technology package consisting of adaptable varieties, simple fertilizer regime and basic pest and disease management.

The second major activity was the workshop on statistics and experimental designs conducted on 16-18 April 2008. Dolores Ledesma, Statistics Specialist at the World Vegetable Center facilitated and conducted the workshop which was attended by 17 participants from collaborating institutions in Solomon Islands. Each participant received a copy of the Training Guide: Experimental Design, Analysis of Variance, CropStat. (75 pages). A CropStat software program on CD was also distributed to the participants.

The third activity was initiating vegetable variety trials in Guadalcanal and Malaita. The World Vegetable Center shipped seeds of improved vegetable varieties including sweet pepper (*Capsicum*), chili, cucumber, bulb onion, pakchoi, tomato, bitter melon, eggplant, pumpkin, yard-long bean and selected indigenous vegetables. Variety trials have been initiated in Guadalcanal (Honiara Plains) by the MAL and KGA. MAL also initiated variety trials for *Capsicum* and Pakchoi in Dala and Busurata, Malaita Province. A greenhouse was constructed at Don Bosco for transplant production.

The project has received some publicity in Solomon Islands. A news article announcing the launching of the smallholder garden project was published in local daily newspaper Solomon Star (Tuesday, 24 July 2007). The article "Project Boost Vegetable Production" described the objectives of the project. Three project documents were prepared and distributed among project partners. These documents are 1) Inception and Planning Workshop: Integrated Crop Management Package for Sustainable Smallholder Gardens in Solomon Islands; 2) Vegetable Production Systems in Guadalcanal, Makira and Malaita, Solomon Islands: A Report on Participatory Rural Appraisal (PRA); and 3) Training Guide on Experimental Design, Analysis of Variance and Crop Stat.

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

Summary

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

A key to achieving high productivity and nutritious tuberous roots of sweet potato is the use of healthy cuttings (termed 'seed') and cultural practices which promote plant vigour and reduced pests and diseases. However, as a prerequisite, there is need to understand the seed supply system. How do farmers retain planting material from crop to crop or obtain new cultivars as those presently grown decline. The project will investigate these aspects in both countries. Pathogen tested material will be introduced and tested using extension practices perfected by the International Potato Center (CIP) in Asian countries. Project work will involve national research and extension institutions, non-government organisation, community-based organisations and lead farmers.

The majority of the project's activities will be implemented in the Solomon Islands (SI) for two reasons: first, recent reviews have shown an urgent need to deal with falling crop yields in areas of high cropping intensity resulting from rapid population increase; second, some work of a similar nature focusing on the highlands has commenced in Papua New Guinea (PNG) during ACIAR project CP/2004/071, therefore this project will focus mainly on the PNG lowlands.

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

Project Information

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

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Collaborating Institutions:

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

Project Budget: \$849,742

Project Duration: 01/09/2006 to 31/08/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 2 (01/09/2007-31/05/2008)

The project Hort/2005/134: The use of pathogen tested planting materials to improve sustainable sweet potato production in the Solomon Islands and Papua New Guinea is led by the East and Southeast Asia and Pacific regional Office (ESEAP) of the International Potato Center (CIP), in collaboration with main partner institutions in the Solomon Islands including the Ministry of Agriculture and Livestock (MAL) and the Kastom Gaden Association (KGA). The overseas collaborators include Queensland Department of Primary Industries and Fisheries (QDPI&F), and the Regional Germplasm Centre of the Secretariat for the Pacific Community in Fiji. This project summary covers approximately nine months of project

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activity, subsequent to the initial annual report submitted in September 2007.

The first objective of the project and primary focus of project activity during the period has involved the description and evaluation of sweet potato seed supply systems in Papua New Guinea and the Solomon Islands. In the Solomon Islands component, initial progress against this objective has included the employment of a project coordinator and volunteer technical assistant in July 2007 and February 2008 respectively.

A comprehensive desk study to review existing literature and additional work on sweet potato in the Solomon Islands and Papua New Guinea (providing valuable data for the workshop to plan the seed survey) was then undertaken.

A workshop to plan and design a survey (including questionnaire) to describe the seed supply system in Solomon Islands was conducted. Following this, a two-day workshop for training surveyors was completed including means of practical application for testing the questionnaire. A survey of sweet potato seed systems across Guadalcanal, Solomon Islands, was then conducted allowing for meaningful recommendations for integrated crop management (ICM) improvement, including seed supply. This process has allowed for varieties of sweet potato with desired characteristics to be identified for pathogen testing (PT). In association with the KGA final moves are now being made to establish an absolute collection of sweet potato varieties from this selection which will be sent for clean up at the Queensland Department of Primary Industries and Forestry (QDPI&F).

The QDPI&F sent a representative to the initial project workshop held in Honiara in February 2007. QDPI&F has collaborated with the project team to introduce plant material from CIP into Australia with the aim of having it pathogen indexed during the life of the project.

The clones will be exposed to thermotherapy to produce PT clones that will later be multiplied at the Regional Germplasm Centre of the Secretariat of the Pacific Community for distribution. Once this material has been "cleaned" it will be re-introduced in Solomon Islands for local trials.

The second project objective is to introduce, refine and disseminate technologies for improved sweet potato production for small holders practising low-input agriculture. Progress against this objective has included planning and preparation for the establishment of "net houses" (igloos) to be used for evaluation centres for later sweet potato propagation. Areas for the establishment of these structures are being arranged in association with KGA and MAL, respectively. Further progress towards the successful establishment of these centres has included advertisement for field technicians to monitor and regulate procedure in and around these sites. KGA and MAL have both initiated a process for recruitment of two technicians respectively.

The third project objective involves the development of participatory methodologies to deliver ICM programs for sweet potato in the Solomon Islands. To progress against this objective, the need to recruit a trainer of trainers (ToT) expert in the Solomon Islands has been identified with the goal of setting up a farmers field school (FFS) and training curriculum. Initial steps towards this include participation in surveys to better understand local farming risks and opportunities.

PC/2006/053: Evaluation of the impact of Dasheen mosaic virus on and other viruses on taro yield

Summary

Two ACIAR-funded projects have worked in parallel with AusAID to develop sensitive tests to detect taro viruses. Safe movement of taro was crucial for the TaroGen project and for the future of taro in the region. These ACIAR projects focused on gathering information about the viruses present in taro, but they did not look in detail at the impact of viruses on taro yield. This study of a taro production system will determine the yield gains from using virus-free planting material, and will also undertake a cost-benefit analysis on the economic benefits of using virus-free planting material. It will particularly focus on *Dasheen mosaic virus* (DsMV) that commonly affects taro throughout the Pacific region.

Project Information

Overseas Collaborating Countries: Fiji, Samoa

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader:

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Collaborating Institutions:

- Ministry of Agriculture, Fiji
- University of the South Pacific, Fiji

Project Budget: \$149,734

Project Duration: 01/06/2007 to 31/05/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 1 (01/06/2007-31/05/2008)

Dasheen mosaic virus (DsMV) commonly affects taro throughout the Pacific region though can be observed more readily in some countries compared to others. Despite its widespread occurrence there have been no studies carried out to determine the impact of this virus on yield in the Pacific. Studies elsewhere on the impact of viruses on crop yields have indicated that yield gains can be achieved when plants are free of viruses. The aim of this project was to determine whether

any impact on yield occurred when taro was infected with DsMV.

Five taro viruses are known for which sensitive diagnostic techniques are now available, as a result of five years of research during the AusAID-funded Taro Genetic Resources: Conservation and Utilization (TaroGen). The taro viruses are from four taxonomic groups. Dasheen mosaic virus (DsMV) is found everywhere; Taro bacilliform virus (TaBV) occurs throughout the region, often without producing symptoms; two rhabdoviruses occur, with Taro vein chlorosis virus (TaVVCV) in both north and south of the Pacific, and Colocasia bobone disease virus (CBDV) confined to Papua New Guinea and Solomon Islands, associated with different diseases depending upon the variety; and Taro reovirus (TaRV), found in New Caledonia, Papua New Guinea, Solomon Islands and Vanuatu. Some of the viruses occur as latent infections, and all can be found in various combinations, making it difficult to ascribe symptoms of infection to a specific project.

As the project participating countries were Fiji and Samoa, taro plants, infected with DsMV (showing visible symptoms), and plants free of DsMV (no visible symptoms) of three accessions from each country were collected. In Samoa locating taro plants with visible symptoms of DsMV was not as easy as expected and as a result, the cultivars which had been identified as desirable to work with, were not available.

In Fiji problems were incurred in locating plants that only contained DsMV. Sampling was carried out on two separate occasions and on both occasions, two of the varieties were infected with TaBV. As TaBV is one of the most widespread of the five taro viruses, the project team agreed that further collecting would not be worthwhile. Attempts could be made to remove the virus, but this would require meristem culture and would not necessarily be successful. After consulting the biometrician at the University of the South Pacific, Alafua Campus, as to the complications that might arise with analysing the experiment, it was agreed that the project would proceed with the material that had been collected. The presence of TaBV does add another dimension to the project and could result in

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more information being available about taro and the impact of viruses on yield.

The six different cultivars from Fiji and Samoa have been screened for the viruses at the tissue culture stage. The Centre for Pacific Crops and Trees implements the same virus testing protocol as used by Queensland University of Technology. As such, all plants are screened at the tissue culture stage for the presence of viruses and then planted in the post-entry quarantine facility, where they are usually re-tested at three month and six month stages. As these plants will be transferred back to the country of origin, and the virus testing is being carried out merely to ensure these viruses are present, virus testing will only be conducted at the three month stage, so each accession will have been tested twice for viruses.

While this process is ongoing, the cultivars are also being multiplied in vitro so that when the virus testing has been completed there will be sufficient numbers of plants to start the field experiments. Funds have been transferred to the Ministry of Agriculture and Primary Industries (MAPI) for modification to the greenhouse for the next stage of the project, and MAPI staff appointed to work on the project. Training in virus testing methodologies has also been conducted for the same MAPI staff. Similarly discussions have been held with USP, Alafua Campus, greenhouse modification designs drawn up and staff appointed. The project has suffered significant delays, due to the departure of one of the key SPC staff, namely Dr Richard Davis, the problems in collecting samples in Fiji, and delays in obtaining virus testing reagents from overseas.

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

Summary

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

Project Information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

Commissioned Organisation: University of Adelaide, School of Agriculture, Food and Wine, Australia

Project Leader:

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Collaborating Institutions:

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

Project Budget: \$131,000

Project Duration: 01/02/2007 to 31/01/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 1 (01/02/2007-31/05/2008)

A collaborative project in Solomon Islands and Papua New Guinea (Lowlands) has started screening for carotenoid-rich sweet potato varieties (i.e. orange-fleshed sweet potato, OFSP), along with carefully considering the social aspects of these and other micronutrient-dense foods, how they fit into the traditional food system, and what factors may be important for promoting them. This project was prompted by studies which indicate suboptimal vitamin A status in population sub-groups in Solomon Islands and PNG, notably in infants, children and pregnant or nursing women. Moreover, during the past 50 years throughout the Pacific and PNG there have been large increases in rates of the so-called metabolic/lifestyle diseases such as diabetes, obesity, cardiovascular disease and certain cancers. These result from overconsumption of refined, nutritionally-poor products such as white flour, white rice and sugar, combined with lack of proper exercise.

Agencies involved include ACIAR, HarvestPlus, International Potato Centre (CIP), Secretariat of the Pacific Community (SPC), Kastom Gaden Association (KGA), Solomon Islands Ministry of Agriculture and Livestock, Island Food Community of Pohnpei, PNG National Agricultural Research Institute (NARI), World Vision, Queensland Department of Primary Industries and Fisheries (QDPIF), and Makira Ulawa Province and community groups.

Over 50 orange/yellow sweet potato varieties were collected and analysed (using high-performance liquid chromatography), as well as a selection of sweet potato leaf samples and other food crops. Collecting areas included the remote Santa Cruz Islands, Makira, Santa Ana, Guadalcanal, Western Solomons/Isabel (by Pita Tikai, KGA), and samples were also sent from Madang, PNG by World Vision.

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Project activity in PNG was limited in 2007 due to the leader's commitments to biofortification programs in several countries, and also the project aim of being mostly Solomons-based.

Promising varieties (with beta-carotene levels over 100 mg/kg dry weight, and which are highly regarded by local consumers for their insect/pathogen resistance, yield, flavour, texture and storage ability) have been identified from this survey and are being multiplied by KGA. This is where the workshops, talks and distribution of promotional material (see below) are essential, as knowledge of the health benefits of micronutrient-rich local foods is not widespread at present. In addition, financial support has been provided to key agriculture and education officers on Makira, who are involved in sweet potato field trials, banana seed gardens, training programs for women, and agricultural extension in the Star Harbour/Weathercoast area.

Cassava and sweet potato leaves were found to be useful sources of carotenoids; for example the reddish leaves of Beraha cassava contained nearly 400 mg/kg of beta-carotene. Cooking in coconut cream enhances carotenoid bioavailability.

Seven nutritional workshops promoting OFSPs, high-carotenoid bananas and nutritious local foods generally, and including information gathering, were held on Makira in October 2007. The workshops were led by Dr Lois Englberger, renowned anthropologist and nutritionist from the Island Food Community, Pohnpei, Micronesia. There was great interest among local people in this activity and over 700 people attended the workshops in total. Participants were particularly keen on the "Go Local" and "Going Yellow" slogans. Several of the workshops were held on the Makira Weathercoast, a remote area with nutrition/food security/income/transport issues.

The social research methods used included ethnography, key informant interviews, informal focus group discussions, free listing, pile sorting, photography, market survey and literature review. In addition, rare high-carotenoid banana germplasm was collected and transferred to Fiji for tissue culture.

Names of the sweet potato and banana varieties, as well as characteristics, beliefs, practices, and traditional knowledge, and factors relating to production, marketing, consumption, and acceptability, all of which impact on the potential for promoting these crops, were explored. Plans are underway to initiate similar efforts on other islands of Solomon Islands and in PNG (in Madang Province, where the population has been identified as having the highest risk of vitamin A deficiency in PNG) in collaboration with World Vision and NARI. Suitable promotional materials (including posters of high-carotenoid local foods) are being developed.

In addition to the survey and social marketing components of the program, imports of OFSP varieties with valuable traits from CIP Peru (via SPC, Fiji) and Indonesia (via QDPIF, Australia) are in progress. Once they clear quarantine, these imported varieties will be tested at several sites in Solomon Islands and PNG.

Health benefits of OFSP aside, the AusAID report "Solomon Islands Smallholder Agriculture Study (Vol 1)" recommended efforts to raise productivity of staple food crops in Solomon Islands to give a much needed boost to the economy. Increasing the appreciation of sweet potato and banana diversity is part of the larger ongoing effort that is needed.

PC/2006/109: The potential for increasing the value of cocoa industries in Solomon Islands, Vanuatu, Fiji and Samoa

Summary

Cocoa production in Solomon Islands, Vanuatu, Fiji and Samoa can make a substantial contribution to economic growth. It can also provide countries with the opportunity to rehabilitate long standing industries based on higher value niche market opportunities. All four countries have the geographic environment for cocoa production, however they face significant production, technical management and marketing problems. Improving these aspects can increase farmer income, as well as building capacity. This project is investigating the current status of the cocoa industries in these countries to identify opportunities for industry development and potential constraints.

Project information

Overseas Collaborating Countries: Fiji, Samoa, Solomon Islands, Vanuatu

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader

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Collaborating Institutions

- Mars Asia Pacific, Australia
- Koko Siga (Fiji) Ltd, Fiji

Project Budget: \$100,000

Project Duration: 01/06/2008 to 28/02/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

First progress report due in 2009.

PC/2006/173: Tongan tropical fruit production - improving genetic diversity and production capacity building

Summary

Tonga wishes to improve the domestic supply of tropical fruits at a subsistence and local trade level, with longer-term potential for export income. An earlier feasibility study (HORT/2006/108) found significant scope to increase the production of the Tongan fruit industry and thus increase household income levels, with opportunities for import replacement, growth of the existing domestic market and, in the longer term, Pacific Inter-island trade, export to New Zealand, Australia and other regional markets.

This project aims to increase the production, productivity and technical capacity of the Tongan tropical fruits industry with an emphasis on the local market. Activities include introduction of new improved cultivars of tropical fruits both from repositories and collections currently in the country and from a range of new tropical fruit species from Australia. This will take place along with development of production packages and improvements in the capacity of Tongans to propagate, produce, harvest, package and market fruit.

Project progress

First progress report due in 2009.

Project Information

Overseas Collaborating Countries: Tonga

Commissioned Organisation: Secretariat of the Pacific Community, Regional Germplasm Centre, Fiji

Project Leader:

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Collaborating Institutions:

- Ministry of Agriculture, Food, Forestry and Fisheries, Tonga

Project Budget: \$399,984

Project Duration: 01/06/2008 to 31/05/2011

ACIAR Research Program Manager: Mr Les Baxter

4.2 Subprogram 2: Sustainable use and management of forestry and fishery resources

This subprogram aims at developing and implementing strategies to sustainably use and manage natural resources associated with forestry and fisheries production. These are often community-owned and publicly managed resources which require broad-based and inclusive management strategies, while at the same time recognising that forestry and fisheries provide significant sources of income.

The Pacific fisheries project cluster has an increased emphasis on freshwater aquaculture and mariculture of sedentary species which provide greater opportunity for income generation at the local level.

Projects:

Project number	Project title	Page
ASEM/2004/011	Evaluating domestic tuna fisheries projects	40
FIS/1997/031	Pearl oyster resource development in the western Pacific	41
FIS/2003/051 (multilateral)	Improving sustainability and profitability of village sea cucumber fisheries in Solomon Islands (WorldFish)	42
FIS/2005/108	Freshwater prawn aquaculture in the Pacific: improving culture stock quality and nutrition in Fiji	43
FIS/2006/138	Developing aquaculture-based livelihoods in the Pacific islands region and northern Australia	44
FIS/2006/172	Winged oyster pearl industry development in Tonga	46
FIS/2007/116	Improving resilience and adaptive capacity of fisheries-dependent communities in Solomon Islands	47

The Pacific forestry project cluster underpins the development of emerging industry opportunities, in particular plantation programs with teak, sandalwood, whitewood and *Flueggea*, while identifying processing opportunities for coconut wood and non-timber forest products.

Projects:

Project number	Project title	Page
FST/2003/049	Review of portable sawmills in the Pacific: Identifying the factors for success	48
FST/2004/053	Establishing forest pest detection systems in South Pacific countries and Australia (Fiji, Vanuatu)	49
FST/2004/054	Improving value and marketability of coconut wood (Fiji, Samoa)	51
FST/2004/055	Domestication and commercialisation of <i>Canarium indicum</i> in Papua New Guinea (and Solomon Islands)	54
FST/2005/089	Improved silvicultural management of <i>Endospermum medullosum</i> (whitewood) for enhanced plantation forestry outcomes in Vanuatu	56
FST/2006/048	Processing of <i>Canarium indicum</i> nuts: adapting and refining techniques to benefit farmers in the South Pacific	58
FST/2007/020	Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by interplanting with <i>Flueggea flexuosa</i> and other Pacific agroforestry species	59
FST/2007/057	Socio-economic constraints to smallholder sandalwood in Vanuatu	60

ASEM/2004/011: Evaluating domestic tuna fisheries projects

Summary

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

The National Fishery Authority is responsible for managing the tuna fisheries and their sustainability. But will domestic activities bring net benefits to the PNG economy as they slowly replace distant water fishing nations access fees? The PNG Government has adopted a policy to support the gradual domestication of the tuna industry in the hope of generating a wider range of returns. Building a framework, beginning with an existing model, in which to assess benefits from domestication is needed. The project will support this by increasing the capacity of NFA, and other agencies, to perform independent economic analysis of proposed domestic tuna fisheries projects. This will be achieved by:

- modifying an existing evaluation framework and apply the framework to measure the private and social net benefits of a locally-based tuna operation in PNG, and
- generalising the framework to be relevant for analysis of policy decisions regarding domestication of tuna and other industries.

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

Commissioned Organisation: University of Queensland, School of Economics, Australia

Project Leader

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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 progress

Year 2 (01/04/2007-31/05/2008)

The results of the RD Cannery labour force survey were analysed and two papers presenting the analysis were completed (see Section 4.4). A significant result of the analysis was the estimate of the shadow-price of labour which is a key variable in the benefit-cost model of the cannery.

A draft version of the benefit-cost model was completed and the methodology and results were discussed in a series of papers (see Section 4.4). Three conference and seminar papers were prepared and presented (papers Section 4.4). A member of the FFA staff, Linda Kaua, received additional training in the methodology and application of the cannery benefit-cost model developed in 2006 at a special training session conducted by the Australian Project Leader, September 17-18, 2007, at FFA headquarters in Honiara. Linda Kaua is now applying the model to evaluate a tuna cannery project in the Solomon Islands and she made a trip to Noro to collect data for this purpose.

FIS/1997/031: Pearl oyster resource development in the western Pacific

Summary

The small island nations of the Pacific have limited opportunities for export trade. Only non-perishable or high value products are feasible due to their remoteness. The production of black pearl and cultured mother-of-pearl shell have become important industries in some Pacific nations. In French Polynesia the black pearl industry is now their major export earner, with over 2,800 kg of cultured black pearls worth an estimated AU\$164 million produced in 1994. The Cook Islands are also producing black pearls, earning AU\$5.25 million in the mid 90's.

Many Pacific island countries, particularly those that are atoll-based, have a strong interest in the development of national pearl oyster culture industries, with several now actively working towards this goal. This is a major priority of the government of Kiribati, along with the Solomon Islands, Fiji and the Cook Islands.

This project follows directly from a previous project that focused on the pearl oyster resources of Kiribati. During that project, which ran from 1993 to 1996, the natural stock of pearl oysters in Kiribati and Fiji was assessed, along with the rates of spatfall of blacklip pearl oysters in the atoll lagoons of Kiribati. Low technology methods for hatchery and nursery culture of the oysters were developed to allow replenishment of natural oyster stocks. Finally practices to improve gem quality of pearls were investigated.

The key elements of this second phase of the project are:

- to further develop and refine hatchery culture techniques for blacklip pearl oysters
- to investigate nursery and growout technology for use in the atolls and open reef systems of Kiribati and other Pacific nations
- to examine the rate of spat collection of blacklip pearl oysters and winged pearl oysters in areas of Fiji and determine the growth rate of spat/individuals under culture conditions
- to produce a simplified manual on the mariculture methods developed for blacklip pearl oysters during the Project

- to develop an appropriate business plan for the establishment of a cultured pearl industry in Kiribati.

This project aims to develop the culture of black pearl oysters and establish an industry to help raise the quality of life of people living in the Pacific atoll islands where there are few potential sources of income or employment.

Project information

Overseas Collaborating Countries: Fiji, Kiribati, Solomon Islands

Commissioned Organisation: James Cook University, Department of Zoology, Australia

Project Leader

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Collaborating Institutions

- Ministry of Environment and Natural Resources Development, Kiribati
- WorldFish Center, Malaysia
- Ministry of Agriculture, Fisheries and Forestry, Fiji

Project Budget: \$1,424,707

Project Duration: 01/01/1998 to 31/07/2008 (Project extended from 01/01/2001 to 31/07/2008)

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 9 (01/06/2007 -31/05/2008)

Annual report not yet submitted by the project leader.

FIS/2003/051: Improving sustainability and profitability of village sea cucumber fisheries in Solomon Islands

Summary

Marine resources are important industries in the Solomon Islands. Tuna and sea cucumber (bêche-de-mer) fisheries contribute the most value to the Solomon's economy; both worth millions of dollars annually. Sea cucumbers have been a valuable export commodity, with the export price rising in recent years, at a time when other commodity prices are falling. Another important aspect of utilising marine resources is food and income for smallholders in coastal communities. Sea cucumber harvesting, usually conducted at the village level, creates significant income flows that stream throughout villages and nearby communities. Recent civil unrest has limited the opportunities available to villagers to earn income. One consequence of this has been increased harvesting of sea cucumber.

Increased harvests in the early 1990s, a time of economic hardship, led to a sharp rise in catches that soon proved unsustainable. Soon after harvests declined dramatically. Numbers of sea cucumber have gradually risen but with economic hardship again prevalent following civil unrest many coastal communities are again increasing harvests, threatening a collapse of fisheries. This would be the worst possible result given that income streams would dry up. Sustainable management is needed to ensure that coastal communities can continue to utilise this vital resources without compromising its long-term value.

The project is aiming to facilitate this through sound, community-based management of the sea cucumber fishery, working in collaboration with the national Department of Fisheries and Marine Resources and the Provincial governments, and to ensure incomes are available to fishers for the bêche-de-mer that

they produce. These objectives will be achieved by:

- working with selected communities to develop sustainable, community-based sea cucumber fisheries and produce high-quality bêche-de-mer
- assisting communities to obtain improved returns for their bêche-de-mer product.

Project information

Overseas Collaborating Countries:
Solomon Islands

Commissioned Organisation: WorldFish Center, New Caledonia

Project Leader:

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Collaborating Institutions:

- Department of Fisheries and Marine Resources, Solomon Islands
- WorldFish Center, Solomon Islands

Project Budget: \$400,000

Project Duration: 01/01/2005 to 31/12/2008

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 1 (01/06/2007-31/05/2008)

Annual report not yet submitted by the project leader.

FIS/2005/108: Freshwater prawn aquaculture in the Pacific: Improving culture stock quality and nutrition in Fiji

Summary

While freshwater prawn aquaculture is a relatively new industry in the Pacific, it has been identified as having great potential for the region. Until recently, freshwater prawn aquaculture in the Pacific was confined to Fiji. But other Pacific Island Nations have indicated a strong interest in developing their own industries, and look to Fiji for culture stock and expertise.

Macrobrachium rosenbergii is the most widely cultured freshwater prawn species in most parts of the world and culture stocks were first introduced to Fiji from Malaysia in the 1980s. Since then the Fijian Fisheries Division (MAFF) has bred postlarvae and provided them free to local farmers for culture. Little is known about the quality or genetic attributes of the introduced freshwater prawn stock, or the impact that subsequent husbandry practices in Fiji may have had on stock quality or relative productivity. It is likely however, that stock quality has declined and modern generations may be significantly inbred.

ACIAR's entry into projects in Fiji on tilapia stock improvement from 1993 to 2001 coincided with the recognition by the Fiji Fisheries Division of the need to actively manage genetic quality in farmed aquatic species to maintain their productivity. There are unconfirmed reports by MAFF staff in Fiji that size at sexual maturation in female prawns has declined over time, an attribute symptomatic of inbreeding problems. And little is known in Fiji about the nutritional requirements of cultured freshwater prawns.

Fijian farmers thus stand to benefit substantially from a freshwater prawn stock improvement program linked to development of low-cost artificial diets. These issues require early attention before they impact negatively on growth and development of the industry in Fiji and more widely in the region.

This project seeks to: 1) compare the relative productivity of the prawn stock currently farmed in Fiji against selected high-performing stocks available in Asia; 2) assist in development of low-cost, nutritionally adequate feeds, based on local ingredients formulated specifically for freshwater prawns.

Project Information

Overseas Collaborating Countries: Fiji

Commissioned Organisation:
Queensland University of Technology,
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Project Leader:

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Collaborating Institutions:

- Ministry of Fisheries and Forests, Fiji
- Secretariat of the Pacific Community, New Caledonia
- University of the South Pacific, Fiji

Project Budget: \$385,680

Project Duration: 01/05/2007 to 30/04/2010

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 1 (01/05/2007-31/05/2008)

Annual report not yet submitted by the project leader.

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

Summary

Aquaculture in the Pacific is expanding and diversifying at a rapid pace. But in order for aquaculture to reach its potential in a sustainable manner, institutional capacity needs enhancing to better support and manage necessary research.

As a component of a previous ACIAR project (FIS/2001/075 *Sustainable aquaculture development in the Pacific Islands region and northern Australia*) managed by QDPI&F a total of 14 'mini-projects' were successfully implemented. The mini-project concept was a novel approach to targeting specific bottlenecks to regional aquaculture. It led to significant capacity-building and generated widespread support for its continuation from the region, including endorsement from the 5th SPC Heads of Fisheries Meeting in April 2006.

The final project review in November 2006 concluded that the mini-project concept had been successful and its results were 'impressive'. This project arose from a specific recommendation that ACIAR commission 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. Importantly, the project will support the SPC's Regional Aquaculture Strategy and supplement the R&D activities of the SPC Aquaculture Action Plan. Its specific objectives are to:

- identify and implement targeted research activities and technology transfer in response to priority issues identified by Pacific Island Countries (PICs)
- increase institutional capacity amongst Pacific Island Countries (PICs) to support and manage research, particularly in Papua New Guinea
- provide technical support for indigenous Australian aquaculture ventures.

Project Information

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:

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Collaborating Institutions:

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

Project Budget: \$1,229,662

Project Duration: 01/10/2007 to 30/09/2011

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 1 (01/10/2007-31/05/2008)

The project commenced in October 2007 and has been running for eight months. No specific milestones have been met yet but progress has been made towards achieving a number of them. The developments of the project to date are detailed in the main body of the report below.

Two Project Team meetings to discuss ideas for mini-projects have been held. The first was held in Noumea, New Caledonia, in Oct/Nov 2007 in conjunction with the SPC Ecosystem Based Fisheries Management and Biosecurity Workshops. The second was in Fiji, at USP Suva and Savusavu, in February 2008. As a result of the meetings, a number of mini-projects have been conceived and approved for development, two of these have progressed to full funding stage. At the time of this report, one had commenced.

Subprogram 2: Sustainable use and management of forestry and fishery resources

The mini-projects approved by the project team and submitted to ACIAR for approval are:

1. Half pearl ('mabe') production in Fiji, Tonga and Kiribati
2. Culture of juvenile sandfish (*Holothuria scabra*) for restocking and sea ranching trials in Fiji
3. Local feed source assessment for subsistence farmers
4. Clownfish aquaculture and village grow-out trials in Vanuatu
5. Bivalve and other invertebrate spat collection trials
6. Improved farming of *Macrobrachium lar*
7. Assess local feed formulation for herbivorous finfish mariculture
8. Capturing juvenile fish for food security
9. Improved access to credit and grant funding for PNG fish farmers
10. Viability of the Pacific to establish specific pathogen free stocks of shrimp
11. Economic assessment of commercial-scale cage culture of Nile tilapia (*Oreochromis niloticus*) in a PNG reservoir
12. Growth potential of existing tilapia strains under local conditions in PICs

Several activities from FIS 2001/075 *Sustainable aquaculture development in the Pacific Islands region and northern Australia* have been progressed or completed during this period:

- Sea Cucumber Manager's Toolbox (coordinated by Ms Hair) has been submitted to the ACIAR Publications Unit, although it won't be published until next financial year.
- The compilation of all miniproject reports from FIS 2001/075 into a single large document has been almost completed (primarily by Ms Marie-Ange Hnaujie at SPC) and will soon be available in PDF format on the SPC Aquaculture Portal.
- Juvenile sandfish produced in the final year of the hatchery component were on-grown in unused shrimp ponds in Ayr, north Queensland.

Ms Hair's role as Northern territory node co-ordinator of ACIAR Project FIS/2003/059 "Sea ranching and restocking sandfish (*Holothuria scabra*) in Asia-Pacific" has not commenced due to delays in release of funding from the Australian side of the project.

FIS/2006/172: Winged oyster pearl industry development in Tonga

Summary

The winged pearl oyster, *Pteria penguin*, is traditionally used for production of half-pearls ('mabe') in Tonga for which there is an export market in Japan and elsewhere. *Pteria penguin* was introduced to Tonga in 1975 by the Tasaki Pearl Co. of Japan. Subsequent research conducted by the Ministry of Fisheries in Tonga and supported by FAO SPADP attracted the interest of local investors and there were 25 small pearl farms in Tonga at the end of 2000. The current value of the industry is not known as the majority of pearls are sold locally.

A major impediment to the sustainability and expansion of the pearl industry in Tonga is a reliable and adequate supply of oysters. Over recent years, poor recruitment of spat has resulted in the harvesting of adult oysters from the wild, which has further impacted recruitment, and natural spat fall of *Pteria penguin* in Vava'u is now extremely limited. This project will focus on the developing of appropriate hatchery culture techniques for *Pteria penguin* and the use of hatchery-propagated oysters for pearl production.

Further development of the pearl industry in Tonga is hindered by a lack of knowledge of the culture requirements of *Pteria penguin*. Research is required to optimise culture methodology and pearl production as a basis for sustainable industry development. This project will address the following major aspects:

- Hatchery culture of *Pteria penguin* and optimisation of hatchery culture techniques
- Nursery culture and grow-out; optimising culture techniques
- Half-pearl production and aspects effecting pearl quality (position, location, time)
- Investigation of round pearl production from *Pteria penguin*
- Training of Tonga Fisheries staff in culture methods and pearl production
- Training of farmers and members of the PGA.

Project Information

Overseas Collaborating Countries:
Tonga

Commissioned Organisation: James Cook University, Department of Marine Biology and Aquaculture, Australia

Project Leader:

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Collaborating Institutions:

- Ministry of Fisheries, Tonga
- Secretariat of the Pacific Community, New Caledonia

Project Budget: \$149,574

Project Duration: 01/06/2007 to 30/11/2009

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 1 (01/05/2007-31/05/2008)

Annual report not yet submitted by the project leader.

FIS/2007/116: Improving resilience and adaptive capacity of fisheries-dependent communities in Solomon Islands

Summary

More than 70% of people in the Melanesian countries of the Pacific derive their basic needs from subsistence fishing and agriculture. Managing the pressures on coastal reef fisheries is a challenge for local communities, who have relatively few tools and traditions to reconcile the limited resources with the increasing demand for them. In parts of Solomon Islands, customary rights to marine resources are well defined and traditional institutions continue to influence small-scale fisheries management.

Within this environment the potential for successful uptake of enhanced community-based management of traditionally owned small-scale fisheries is high. However a broader management framework that meets the needs of other environments must be more flexible, and the WorldFish Center aims to develop and test a generic adaptive management framework and a set of diagnostic tools that feeds directly into its application.

The tools and the management framework will form the basis of community-based management plans that will assist communities to address threats from within the domain of the fishery (fish stock, habitat, fishers economic viability) while reducing their vulnerability to external threats (such as ecosystem change, trends in world markets, fuel costs). A sustainably managed marine environment will contribute to a resilient ecosystem, and this increased resilience should further help the communities to better adapt to future economic, social and environmental changes.

Project information

Overseas Collaborating Countries: Solomon Islands

Commissioned Organisation: WorldFish Center, Malaysia

Project Leader

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Collaborating Institutions

- Ministry of Fisheries and Marine Resources, Solomon Islands
- Foundation of the Peoples of the South Pacific International, Fiji

Project Budget: \$749,999

Project Duration: 01/07/2008 to 30/06/2011

ACIAR Research Program Manager: Mr Barney Smith

Project progress

First progress report due in 2009.

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

Summary

Portable sawmills are cheaper to use than conventional mills, causing less collateral damage than conventional harvesting. One important benefit is in allowing small-scale operators to undertake high-quality sawmilling and gain much of the value added in the production of milled forest products. These benefits saw more than 7,000 portable mills purchased throughout the Pacific. Less than 20 per cent are believed to be operating effectively. A lack of technical expertise, poor maintenance and market accessibility are behind this low rate. These causal factors are being evaluated by studying a range of mill operations to design strategies for more effective usage. Appropriate recommendations will then be provided to key stakeholders for dissemination.

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

Commissioned Organisation: Australian National University, School of Resources, Environment and Society, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: \$149,989

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

ACIAR Research Program Manager: Dr Russell Haines

Project progress

Year 3 (01/06/2007-31/05/2008)

Annual report not yet submitted by the project leader.

FST/2004/053: Establishing forest pest detection systems in South Pacific countries and Australia

Summary

The aim of the project is to reduce the risk of serious damage by exotic pests to the valuable timber resources of Fiji, Vanuatu and Australia by establishing efficient detection systems for target pests in high hazard sites. Simple and robust technologies involving static trapping systems and sentinel plantings will be developed. In particular, the project aims to minimise losses in the valuable plantations of Fiji and the emerging plantation industry of Vanuatu. Some major target pests are the cedar shoot caterpillar, wood and bark beetle pests of pines and hardwoods, lepidopterous defoliators, guava rust and *Erythrina* gall wasp. This is part of a 'neighbourhood watch' approach to incursion management that will benefit all regional countries, including Australia.

Project Information

Overseas Collaborating Countries: Fiji, Vanuatu

Commissioned Organisation: Queensland Department of Primary Industries and Fisheries, Australia

Project Leader:

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Collaborating Institutions:

- Forestry Tasmania, Australia
- Secretariat of the Pacific Community, Fiji
- Ministry of Fisheries and Forests, Fiji
- Vanuatu Quarantine and Inspection Services, Vanuatu
- Department of Forests, Vanuatu
- Ministry of Agriculture, Sugar and Land Resettlement, Fiji

Project Budget: \$399,526

Project Duration: 01/01/2006 to 31/12/2008

ACIAR Research Program Manager: Dr Russell Haines

Project progress

Year 2 (01/01/2007-31/05/2008)

During the past 18 months of the project since the initial workshop in October 2006, country participants have been undertaking static trapping surveys as per the project plans developed at the workshop. Short visits were made to Vanuatu and Fiji in mid-2007 to review progress in undertaking the static trapping surveys and longer visits were made at the end of 2007 to conduct surveys (Vanuatu) and undertake conservation work on insect collections (Fiji). The Australian component of the study investigating trap / lure combinations in mid-rotation pine plantations has been expanded from the original proposal to allow time to refine the static trapping method to better suit use in tropical climates. All the fieldwork for the study investigating trap / lure combinations for wood-borer surveys in mid-rotation eucalypt plantations has been completed and some exploratory analysis has been done.

Static trapping surveys done by country participants have experienced difficulties through a combination of theft / damage, poor preservation of specimens in the traps and personnel changes. Despite this, the surveys have yielded specimens that have been positively identified, one of which was of quarantine significance - the Asian ambrosia beetle (*Xylosandrus crassiusculus*). To overcome the operational difficulties experienced with the first year of static trapping several changes have been instituted for the second year of the trapping program. The most important change is the incorporation of an additional two visits per country, each of a fortnight duration in 2008 and early 2009. The purpose will be to assist the countries in undertaking a full static trapping cycle each visit and getting the captured returned promptly to Australia for sorting and identification.

The planning for infrastructure improvements in Vanuatu and Fiji has progressed. Designs for laboratory facilities for the Vanuatu Department of Forests and Quarantine Inspection Services have been drawn up and building is scheduled to commence mid-2008. Materials for building maintenance and equipment upgrade for

the insect laboratory at Fiji Forest Department have been ordered and work should be again in progress by mid-2008. Importantly this maintenance and equipment upgrade will overcome the problems with humidity in the room housing the insect collection that had resulted in some deterioration in the condition of insects in the collection. A project visit to Fiji in December 2007 cleaned the insect collection to reverse some of the damage to specimens and take steps to prevent further deterioration of the specimens.

There have been a number of personnel changes to the project during the past year. In Vanuatu, Tou'fau Kalsakau was replaced by Presly Dovo in May 2007 as the main VFD representative on the project. Subsequently, Presly was awarded a Darwin Initiative scholarship to do postgraduate study, majoring in entomology at the University of the South Pacific. In January 2008 Anne Marie Sariset took over as the main VFD representative on the project. Regrettably, Atchison Smith Marav, who had been our project representative on Santo, died last year following an accident. This, coupled with the destruction of the forestry offices on Santo from a fire last year was a set back to the project (insect specimens and equipment was lost). In Fiji, quarantine staff have not been undertaking the servicing of the static traps installed at the wharf or container facility as planned. The ongoing servicing of these traps was done by Lusiana Tuvou (FFD), which she did in addition to servicing the traps installed in plantations and nurseries. We have reviewed the value of the static traps installed at the wharf and container facilities on Fiji and decided not to continue trapping at these sites because of low catch rates and difficulties in servicing the traps. Instead, we will focus on trapping in urban areas away from the port and are holding discussions with entomology staff from the Department of Agriculture and Fisheries of the possibility of coordinating the static trapping for forest insects with the fruit fly trapping program they maintain. While quarantine staff will no longer be involved with the static trapping program, their role in at-border forest biosecurity is still vital. However, skill-levels among quarantine staff in the recognition of forest and timber insects in cargo is quite low. To address this we will run a training course on this topic during a visit planned for later in 2008.

FST/2004/054: Improving value and marketability of coconut wood

Summary

In the Pacific region, large areas of coconut palm (*Cocos nucifera*) have grown senile, and copra yields are greatly reduced as a consequence. The cost and phytosanitary implications of clearing senile palms are real impediments to replanting.

Production of flooring material from senile stems has been proposed as means of clearing the old plantations while generating some income. There is very high demand for flooring products in Asia, America and Europe – the US market alone is forecast to grow by 40% in the four years to 2008. Generally however, while market demand is increasing, the supply of suitable resources is decreasing, particularly for hard, dark timbers from sustainable resources.

Market appraisals by two Australian companies have indicated that the unique attractive appearance of cocowood, combined with its hardwearing properties and sustainable plantation origins, will ensure high levels of consumer demand. Limited volumes of coconut wood flooring have been produced in Indonesia and exported to Europe; however, there are at present no known industry-scale coconut wood flooring manufacturers.

The project arose from a coconut workshop held at Nadi, Fiji in November 2004. It aims to develop appropriate processes and provide the technical information that will underpin the manufacture and broad acceptance of coconut wood in the international high value flooring market.

Specific project objectives are to:

- characterise coconut 'wood' resource properties relevant to the design and manufacture of high quality flooring
- develop processing systems and profiles for high quality flooring
- define appropriate grading standards, product specifications and quality control systems
- develop options to utilise the low-quality portion of the stem.

Project Information

Overseas Collaborating Countries: Fiji, Samoa

Commissioned Organisation: Queensland Department of Primary Industries and Fisheries, Australia

Project Leader:

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Collaborating Institutions

- Secretariat of the Pacific Community, Fiji
- Coconut Industry Development Authority, Fiji
- Strickland Bros Ltd, Samoa
- Ministry of Natural Resource & Environment, Samoa
- Department of Forests, Fiji

Project Budget: \$520,552

Project Duration: 01/05/2007 to 30/04/2010

ACIAR Research Program Manager: Dr Russell Haines

Project progress

Year 1 (01/05/2007-31/05/2008)

The coconut palm, regarded as 'the tree of life', is a significant source of food (the nut) and saleable product (traditionally copra) that provides essential income for villages. Palm senility and associated loss of productivity is incompatible with a perception of sustainable use, and villagers have already demonstrated their willingness to harvest senile stems for a cash return.

The project addresses key issues relating to the acceptance of coconut wood into the high value flooring market. The project is focusing on developing processing systems and profiles for high quality flooring, and defining appropriate grading standards, product specifications and quality control systems. Examining the variation in resource quality will help to define grading rules that will optimise the utilisation potential of cocowood produced from different parts of the palm stem.

Communication and networks

Several initiation meetings and visits to facilities and palm plantation were conducted in Fiji and Samoa by project leaders and technical staff in July, August and September, 2007, continuing to build a network of interested parties and conduct trials with in-country participants. Further meetings with partners and collaborators took place in Fiji and Samoa in May 2008. These generated constructive discussions about progress and future directions.

A network of industry contacts in Australia, Fiji and Samoa has been established, including flooring market and production specialists, potential resource suppliers and processors. In February 2008, the project team briefed representatives from the Australian Department of Foreign Affairs and Trade, Australian High Commission Samoa, Samoan Ministry of Natural Resources, Environment and Meteorology and Samoan Ministry of Agriculture on the project, which resulted in television coverage in Samoa.

A training workshop for cocowood primary processing (supported by The Crawford Fund) was delivered by project staff in Fiji, September 2007. The 20 participants represented project partners and interested parties from the Pacific region.

A project website 'cocowood' www.cocowood.net was launched in February 2008. It delivers information and news about the project and encourages communication between industry, research and other stakeholders. Website inquiries have been received from North America, Papua New Guinea, Australia and the Philippines.

Characterisation of cocowood resource properties

Cocowood was sampled from the resource in Fiji and Samoa and wood properties are being tested in Fiji and Australia to evaluate moisture content, density, shrinkage, grain deviation. Interestingly, preliminary growth strain measurements indicate tension in lower stem and compression at upper stem, beneath the frond break. These characteristics are different from the growth strain typical of hardwood and softwood woody stems and these data will be the first reported for the trait.

After a delay in shipping the samples to Brisbane, we have begun preliminary tests on mechanical properties and samples have been prepared for workability studies.

Microorganisms that colonise cocowood as it dries cause aesthetic degrade, reducing its value for appearance-grade products such as flooring. Our research underway to identify key microbes responsible for staining will help develop suitable treatments to protect cocowood. Several species of fungi have been isolated from stained cocowood and we are testing which ones leave a permanent, visible stain. We have also begun to address the problem of heavy colonisation by non-staining moulds which could be a risk to cocowood processing workers who have prolonged exposure to mould spores. Preliminary trials have begun in Fiji and Samoa to evaluate potential treatments for preventing the prolific growth of fungi on cocowood as it dries.

Processing systems and profiles for high quality flooring

Boral Timber (Murwillumbah Engineered Flooring Plant), Australia's major engineered flooring manufacturer, is collaborating with DPI&F to develop appropriate processing systems and product designs for cocowood.

Future work will address grading standards, product specifications, quality control systems as well as options for using the low-quality portion (core segment) of the stem.

Several initiation meetings and visits to facilities and palm plantation were conducted in Fiji and Samoa by project leaders and technical staff in July, August and September, 2007, continuing to build a network of interested parties and conduct trials with in-country participants. Further meetings with partners and collaborators took place in Fiji and Samoa in May 2008. These generated constructive discussions about progress and future directions.

A network of industry contacts in Australia, Fiji and Samoa has been established, including flooring market and production specialists, potential resource suppliers and processors. In February 2008, the project team briefed representatives from the Australian Department of Foreign Affairs and Trade, Australian High Commission Samoa, Samoan Ministry of Natural Resources, Environment and Meteorology and Samoan Ministry of Agriculture on the project, which resulted in television coverage in Samoa.

A training workshop for cocowood primary processing (supported by The Crawford Fund) was delivered by project staff in Fiji, September 2007. The 20 participants represented project partners and interested parties from the Pacific region.

A project website 'cocowood' www.cocowood.net was launched in February 2008. It delivers information and news about the project and encourages communication between industry, research and other stakeholders. Website inquiries have been received from North America, Papua New Guinea, Australia and the Philippines.

Characterisation of cocowood resource properties

Cocowood was sampled from the resource in Fiji and Samoa and wood properties are being tested in Fiji and Australia to evaluate moisture content, density, shrinkage, grain deviation. Interestingly, preliminary growth strain measurements indicate tension in lower stem and compression at upper stem, beneath the frond break. These characteristics are different from the growth strain typical of hardwood and softwood woody stems and these data will be the first reported for the trait.

After a delay in shipping the samples to Brisbane, we have begun preliminary tests on mechanical properties and samples have been prepared for workability studies.

Microorganisms that colonise cocowood as it dries cause aesthetic degrade, reducing its value for appearance-grade products such as flooring. Our research underway to identify key microbes responsible for staining will help develop suitable treatments to protect cocowood. Several species of fungi have been isolated from stained cocowood and we are testing which ones leave a permanent, visible stain. We have also begun to address the problem of heavy colonisation by non-staining moulds which could be a risk to cocowood processing workers who have prolonged exposure to mould spores. Preliminary trials have begun in Fiji and Samoa to evaluate potential treatments for preventing the prolific growth of fungi on cocowood as it dries.

Processing systems and profiles for high quality flooring

Boral Timber (Murwillumbah Engineered Flooring Plant), Australia's major engineered flooring manufacturer, is collaborating with DPI&F to develop appropriate processing systems and product designs for cocowood.

Future work will address grading standards, product specifications, quality control systems as well as options for using the low-quality portion (core segment) of the stem.

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

Summary

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

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

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

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

Project Information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

Commissioned Organisation: James Cook University, Agroforestry and Novel Crops Unit, Australia

Project Leader:

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Collaborating Institutions:

- National Agricultural Research Institute, Papua New Guinea
- Cocoa and Coconut Institute, Papua New Guinea
- Commodities Export Marketing Authority, Solomon Islands
- Kastom Gaden Association, Solomon Islands
- Pacific Nuts Co., Vanuatu

Project Budget: \$634,571

Project Duration: 01/01/2006 to 31/12/2009

ACIAR Research Program Manager: Dr Russell Haines

Project progress

Year 2 (01/01/2007-31/05/2008)

During the 2007-2008 period, the work of the *Canarium indicum* (Galip nut) Domestication and Commercialization Project has centred on exploration and characterization of genetic resources of the species. Project staff have visited often remote areas of five Provinces of PNG (Bougainville, East New Britain, mainland and island areas of Madang, New Ireland and West New Britain). Within the five provinces, 13 villages were selected for prospection, tree selection / collection. Additionally, meetings on project objectives and activities were held with local authorities and landowners. After these consultations, almost 10,000 individual fruits (nuts) were collected from more than 400 trees and transported to the NARI Lowlands Agricultural Experiment Station in Keravat. Project staff carried out detailed measurements of fruit characteristics of these samples, based on which they identified trees in each population with superior commercial characteristics, particularly for traits related to kernel size. One or more return visits to each site was then made in order to finalize tree selections with local landowners (this

involved both screening of preliminary selections and also to supplementation with selections made by the farmers themselves). Subsequently, trees in each population were pruned in order to stimulate production of branches suitable for marcotting (air-layering), i.e. to permit their propagation. This prospection and collection work is an important first step in planned domestication. It was initially scheduled for the first year of the project, but could not be carried out as planned, due to key staff members being temporarily assigned to deal with the cocoa pod borer emergency.

Concurrently, work on developing vegetative propagation methods for Galip-nut has continued. Four additional experiments looking at factors affecting rooting were established. These look at various factors (e.g. stockplant shade, rooting media), including the combination of the best treatments to date with high-quality cuttings (i.e. from healthy, vigorous seedlings). These experiments are expected to yield rooting percentages higher than the 40% obtained to date. Work has also continued on marcotting of adult trees; 8 of 14 trees included in the marcotting experiment have produced at least one rooted marcot.

Project staff have begun the compilation of a database of parties interested in the development of the Galip-nut supply chain. A newsletter has been produced in order to facilitate this process by raising awareness of the Project.

FST/2005/089: Improved silvicultural management of *Endospermum medullosum* (whitewood) for enhanced plantation forestry outcomes in Vanuatu

Summary

Exploitation of whitewood (*Endospermum medullosum*) in natural forests has been an important economic activity in Vanuatu, with a significant local value-adding industry producing sawn timber and edge-glued panel for export to Japan. Compared to the log export operations in some areas of the Pacific, Vanuatu's whitewood industry has captured, for the benefit of the nation, much more of the value inherent in the timber. The government of Vanuatu has stated that a seven-fold increase in the plantation estate is a priority over the next 18 years, and there is now international investor interest in a whitewood plantation industry in Vanuatu. Properly developed, the industry associated with such a plantation estate could have an annual export value approaching US\$50 million. The single most important technical impediment to realising this economic opportunity is the absence of silvicultural prescriptions that will optimise productivity and product value.

A significant amount of genetic improvement and propagation research has already been carried out under the South Pacific Regional Initiative On Forest Genetic Resources (SPRIG) project Phases 1 and 2. But little research has occurred in the areas of establishment silviculture and stand management and no set of clear prescriptions is available to landowners who may wish to manage their land for whitewood timber production. Current plantation practices are consequently poor, seriously reducing the economic returns to landholders and preventing the development of a more substantial export market and sophisticated processing industry.

The project will develop comprehensive silvicultural prescriptions for community-based plantation forestry with whitewood in Vanuatu. Project objectives are to:

- identify site selection criteria, and characterise site availability, with focus on Espiritu Santo Island
- define appropriate establishment silviculture prescriptions
- define stand management systems that optimise economic returns (through manipulation of both productivity and wood quality).

Project Information

Overseas Collaborating Countries:
Vanuatu

Commissioned Organisation: Southern Cross University, Australia

Project Leader:

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Collaborating Institutions:

- Queensland Department of Primary Industries and Fisheries, Australia
- Department of Forests, Vanuatu
- Melcoffee Sawmills, Vanuatu

Project Budget: \$660,116

Project Duration: 01/07/2007 to 30/06/2011

ACIAR Research Program Manager: Dr Russell Haines

Project progress

Year 1 (01/07/2007-31/05/2008)

The Whitewood project started in late November 2007 with the visit of five Australian members of the project to Santo, and a busy ten-day period of planning and beginnings of work with collaborators Department of Forestry Vanuatu and Melcoffee Sawmills.

Our greatest progress to date has been in the area of identifying site selection criteria for Whitewood plantations on Espiritu Santo Island, Vanuatu. Extensive soil sampling was done, in coordination with the establishment of thirty Permanent Sample Plots in Whitewood plantations. These are useful in estimating yields and will be monitored throughout the project.

Using the set of soil samples taken along with tree measurements and existing knowledge summarised in the VANRIS system, project soil scientist John Grant estimates that there are approximately **69,203 hectares suitable** for successful Whitewood plantations, out of 395,120 ha on the island. We did not detect a range of

Subprogram 2: Sustainable use and management of forestry and fishery resources

site indices in this area, with the soils being broadly similar across all plots sampled and precipitation adequate for good tree growth.

From December 2007 through to May 2008 a series of trial plots were established, to deal with issues of weed control, plantation management and spacing-thinning. These will be augmented in September 2008 by another series of trials, focussing on agroforestry combinations and mixtures with other tree species.

Wood quality sampling will begin in July 2008, in conjunction with collection of seed and cuttings from seed orchards.

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

Summary

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 post-harvest 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.

Project Information

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
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Collaborating Institutions:

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

Project Budget: \$651,776

Project Duration: 01/01/2008 to 31/12/2010

ACIAR Research Program Manager: Dr Russell Haines

Project progress

First progress report due in 2009.

FST/2007/020: Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by interplanting with *Flueggea flexuosa* and other Pacific agroforestry species

Summary

A significant community-based teak plantation industry is now emerging in the Solomon Islands. Teak is a high value timber with a strong market demand that is likely to escalate as the supply of timber from natural forests dwindles. This project aims to develop agroforestry systems, suitable for smallholders, based on wider final-crop spacing of teak or rosewood, and row inter-planting with tree species that could be harvested as a commercial crop at an earlier age. This will address the silvicultural problems that have become evident as a result of grower reluctance to thin pre-commercially. The project will also investigate high value products from small sized logs of teak, rosewood and interplanted species. Based on some quite conservative assumptions, annual yield from the teak component alone of a realistic 20,000 hectare estate would be 200,000 cubic metres with a Free On Board value of US\$90 million.

Project Information

Overseas Collaborating Countries: Solomon Islands

Commissioned Organisation: Griffith University, Centre for Forestry and Horticultural Research, Australia

Project Leader:

Professor Gary Bacon
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Email: g.bacon@griffith.edu.au

Collaborating Institutions:

- Queensland Department of Primary Industries and Fisheries, Australia
- Integrated Tree Cropping Limited, Australia
- N&S Consulting, Solomon Islands
- Ministry of Natural Resources, Solomon Islands
- Maraghoto Consultancy Services, Solomon Islands
- Pacific Australia Reforestation Co Ltd, Australia

- Solomon Islands College of Higher Education, Solomon Islands
- Ministry of Education and Training, Solomon Islands
- Kolombangara Forest Products Ltd, Solomon Islands

Project Budget: \$859,765

Project Duration: 01/04/2008 to 31/03/2012

ACIAR Research Program Manager: Dr Russell Haines

Project progress

First progress report due in 2009.

FST/2007/057: Socio-economic constraints to smallholder sandalwood in Vanuatu

Summary

Vanuatu has a large rural population with high population growth and typically low income. There is a need for the development of industries that deliver income into remote communities. Commercial smallholder sandalwood agroforestry is an industry that can help increase both rural income and export earnings. Thus smallholder farmers in Vanuatu may be able to capitalise on recognised future global shortages of sandalwood by building an industry that sustainably harvests from existing stands and plants the local species *Santalum austrocaledonicum* – for which an earlier ACIAR project (FST/2002/097) identified populations of a quality that meets the international standard.

While a marked increase in sandalwood planting has occurred in Vanuatu over the past 5 years, there are a number of technical and socioeconomic factors that limit the expansion of this industry. This project aims to address the knowledge and resource gaps that currently constrain the industry's development. By supporting the development of community sandalwood agroforestry this project can bring positive social, economic and environmental benefits to the people of Vanuatu. The project outputs may also have relevance to potential sandalwood planting by indigenous communities in north Queensland.

Project information

Overseas Collaborating Countries: Vanuatu

Commissioned Organisation: James Cook University, Australia

Project Leader

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Collaborating Institutions

- Department of Forests, Vanuatu

Project Budget: \$149,000

Project Duration: 01/06/2008 to 31/01/2010

ACIAR Research Program Manager: Dr Russell Haines

Project progress

First progress report due in 2009.

4.3 Subprogram 3: Farming systems economics, marketing and biosecurity

This cluster of projects comprises a range of targeted policy and market analysis activities and a capacity-building program designed to underpin subprograms 1 and 2, or to provide analysis and policy support to help Pacific islands governments deal with specific issues.

Projects:

Project number	Project title	Page
ADP/2003/069	Policy options for improving the value of land use in smallholder Fijian agriculture	62
ADP/2005/140	Participatory needs assessment for capacity building in extension (Pacific Islands)	63
ASEM/2004/011	Evaluating domestic tuna fisheries projects (PNG, Solomon Islands)	64
HORT/2007/072	Postgraduate scholarship scheme for University of the South Pacific (Fiji, Samoa, Solomon Islands, Tonga, Vanuatu)	65

ADP/2003/069: Policy options for improving the value of land use in smallholder Fijian agriculture

Summary

Appropriate policy interventions need decision-makers who are up to date on relevant information. Analytical tools to support policy making are also vital. In the case of food, agriculture and natural resource management inappropriate policies can be detrimental to supporting agricultural development and its important role in broader economic growth.

Fiji is a resource rich country poor in terms of economic growth. The climate, considerable areas of good soils and arable land and rich marine and forest resources should ensure high levels of agricultural productivity. Although the workforce is relatively small it is highly skilled. All of the these factors, combined with tourism as an ongoing contributor, should combine to result in good economic growth, rather than the poor performances characteristic of the last 15 years, when real economic growth in Fiji has averaged 2.6 per cent a year.

Agriculture as a sector is vital to improving this overall performance, accounting for 22 per cent of total official GDP, but much beyond this is uncertain. The percentage agriculture contributes to the real economy and the numbers it employs are unknown. This level of uncertainty spreads beyond overall impacts with levels of production from smallholders to subsistence farmers and land use patterns and trends also being largely unknown. With significant challenges relating to land tenure, particularly in the sugar industry as a result of reforms, and little information relating to the impacts of production on poor dietary nutrition and increasing obesity levels appropriate policy interventions are needed, based on sound and accurate information.

The aim of this project is to guide policy intervention in the agricultural sector in order to improve the overall efficiency of the agri-food policy system. This broad aim will be achieved through:

- a measuring and forecasting system of smallholder production, consumption and sales
- understanding price elasticities of major foods
- a market-based model for policy simulations.

Project information

Overseas Collaborating Countries: Fiji

Commissioned Organisation: Deakin University, School of Accounting, Economics and Finance, Australia

Project Leader

Mr Henry Haszler
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Collaborating Institutions

- Ministry of Agriculture, Sugar and Land Resettlement, Fiji
- Secretariat of the Pacific Community, Fiji

Project Budget: \$724,445

Project Duration: 01/07/2005 to 30/11/2008 (Project extended from 01/07/2008 to 30/11/2008)

ACIAR Research Program Manager: Dr Simon Hearn

Project progress

Year 3 (01/07/2007-30/06/2008)

Annual report not yet submitted by the project leader.

ADP/2005/140: Participatory needs assessment for capacity building in extension (Pacific Islands)

Summary

One of the key priorities emerging from the Pacific Extension Summit hosted by Tonga in November 2005t was the need to build the capacity of extension staff and associated institutions to undertake participatory research and extension (PARE). In support of the process this project will conduct a participatory needs assessment. It will study a range of Pacific islands and different institutions, to account for variations in context (e.g. social and cultural differences, previous institutional experiences, farmers needs) and differences in institutional roles (e.g. of tertiary institutions, NGO networking agencies, government extension and research staff).

Project information

Overseas Collaborating Countries: Fiji, South Pacific general

Commissioned Organisation: University of Queensland, School of Natural and Rural Systems Management, Australia

Project Leader

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Collaborating Institutions

- Secretariat of the Pacific Community, Development of Sustainable Agriculture in the Pacific, Fiji
- University of the South Pacific, School of Agriculture and Food Technology, Fiji

Project Budget: \$77,600

Project Duration: 01/07/2006 to 30/09/2008
(Project extended from 01/01/2008 to 30/09/2008)

ACIAR Research Program Manager: Dr Simon Hearn

Project progress

Year 2 (01/07/2007-31/05/2008)

Annual report not yet submitted by the project leader.

ASEM/2004/011: Evaluating domestic tuna fisheries projects

Summary

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

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

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

- modifying an existing evaluation framework and apply the framework to measure the private and social net benefits of a locally-based tuna operation in PNG, and
- generalising the framework to be relevant for analysis of policy decisions regarding domestication of tuna and other industries.

Project Information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

Commissioned Organisation: University of Queensland, School of Economics, Australia

Project Leader:

Professor Harry Campbell
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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 progress

Year 3 (01/04/2007-31/03/2008)

The results of the RD Cannery labour force survey were analysed and two papers presenting the analysis were completed. A significant result of the analysis was the estimate of the shadow-price of labour which is a key variable in the benefit-cost model of the cannery. A draft version of the benefit-cost model was completed and the methodology and results were discussed in a series of papers. Three conference and seminar papers were prepared and presented.

A member of the FFA staff, Linda Kaua, received additional training in the methodology and application of the cannery benefit-cost model developed in 2006 at a special training session conducted by the Australian Project Leader, September 17-18, 2007, at FFA headquarters in Honiara. Linda Kaua is now applying the model to evaluate a tuna cannery project in the Solomon Islands and she made a trip to Noro to collect data for this purpose.

HORT/2007/072: Postgraduate Scholarship Scheme for University of South Pacific, Fiji

Summary

ACIAR has commissioned the University of the South Pacific (USP) to manage and administer a Postgraduate Scholarship Scheme, initially for three years, focusing on those wishing to pursue further studies in agriculture, forestry, fisheries and agricultural economics.

Project Information

Overseas Collaborating Countries: Fiji

Commissioned Organisation: The University of the South Pacific, Fiji

Project Leader

Dr Pa'olelei Luteru

Project Budget: \$460,334

Project Duration: 25/02/2008 to 30/06/2011

ACIAR Research Program Manager: Mr Les Baxter

Project progress

First progress report due in 2009.

5 Projects expected to start in 2008—09

Project number	Project title
FIS/2006/126	Developing pond aquaculture for sandfish in Asia–Pacific (Fiji)
FST/2008/010	Development and delivery of germplasm for sandalwood and whitewood in Vanuatu and Northern Australia
HORT/2007/039	The control of basal stem rot of oil palm caused by Ganoderma in Solomon Islands
HORT/2007/118	Alternative disinfestation treatments for fresh produce commodities from Pacific islands countries (Fiji, PNG)
PC/2007/039	The control of basal stem rot of oil palm caused by Ganoderma in Solomon Islands
PC/2008/003	Strengthening the Fiji papaya industry through applied research and information dissemination
PC/2008/011	Ornamental horticultural crop development for Fiji, Papua New Guinea and Northern Australia

6 Pacific Islands chapter from the Annual Report 2007-08

AOP budgeted expenditure in 2007–08	\$2,781,416
Actual expenditure in 2007–08	\$3,196,569
Expenditure in 2006-07	\$3,143,726
Expenditure in 2005-06	\$2,570,278

Expenditure includes both bilateral and multilateral projects

Key performance indicators	Performance 2007-08
Fisheries management arrangements enhanced or economic analyses completed in at least two countries	The establishment of effective community-based management plans for sea cucumber resources in Solomon Islands has been the focus of a three-year effort in collaboration with the WorldFish Center. Success has proved elusive, and a major new activity is planned to assist communities to better manage their inshore reef-based resources.
Demonstrated integration of existing farming systems knowledge and/or adoption of earlier research in at least four Pacific island projects	Integration of existing farming systems knowledge/adoption of earlier research is demonstrated in several Pacific horticulture projects. For example, one program is utilising root crop germplasm from previous ACIAR PNG and Pacific projects; another is using earlier plant defence stimulator research from a previous project in China; another builds on integrated pest management tools developed in China and DPR Korea; and two others incorporate outputs from sweet potato research in PNG.
Demonstrated development and successful field testing of integrated crop management practices for at least two horticultural crops	Development and successful field testing of integrated crop management practices for Kabocha squash in Tonga (including an Integrated Pest Management strategy) and in brassicas (broccoli and cabbage) in Fiji, with a particular focus on integrated pest management strategies using either alternatives to synthetic pesticides or more targeted use of lower amounts of safer pesticides.
Improved agricultural statistics or marketing systems indentified, developed and tested in at least two Pacific island countries	In a project measuring and forecasting systems for smallholder production and consumption and sales and market-based models for policy simulations have been developed and are being used in the project. In another, a computable general equilibrium model supplemented by partial equilibrium studies has been used to assess the economic and environmental impacts on the Fijian economy of agricultural trade liberalisation, increased agricultural production and trade, providing valuable information for the formulation of policy advice.
Field testing of promising sustainable management practices and values addition demonstrated in forestry and agroforestry projects	Projects aimed at testing and implementing sustainable agroforestry systems with high value species are under way with whitewood in Vanuatu, and another with teak and rosewood in Solomon Islands. Another project aimed at developing coconut wood for the Australian flooring market is making good progress.

6.1 Position

ACIAR's position in the Pacific islands will continue to develop in line with broader Australian development assistance priorities. There is an increasing awareness of the importance of changing economic and environmental situations and the vulnerability of small developing island states if flexibility and adaptation to change is not achieved. While each of the Pacific island countries has specific agricultural industry constraints and issues, these countries have a range of common challenges including eroding tariff preferences, population and urban growth, migration of skilled labour, resource depletion and degradation and risks from global warming.

Participation in regional projects that address common problems has assisted with helping to

overcome the limited capacity of many countries to engage in collaborative activities. ACIAR's 2007–08 program has had a strong emphasis on working with Pacific Regional Organisations to improve effective delivery of outputs.

In 2007–08 the ACIAR program has taken a holistic approach, linking agriculture, forestry, fisheries and environment more closely. ACIAR has had the opportunity through a number of projects to explore new niche agricultural, fisheries and forestry products to achieve diversification and income growth as well as facilitating domestic and export market access through a focus on biosecurity issues and improved quarantine resources.

6.2 Achievements

Subprogram 1: Improving incomes through productive farming systems

Sustainable aquaculture development is imperative in the Pacific islands region. A series of 14 miniprojects has focused on eight aquaculture commodities in nine Pacific island countries. Examples of outcomes include determination of the viral disease status of *Penaeus monodon* shrimp stocks in Fiji, paving the way for the development of improved quarantine and testing procedures, and demonstration that the native freshwater prawn *Macrobrachium* lar can be successfully cultured in ponds as an alternative to the introduced *M. rosenbergii*. Other projects demonstrated improvements in husbandry for artisanal fish farmers in PNG and Fiji through formulation of cheap, locally available fish feeds. In Solomon Islands the research team developed improved sponge culture methods and investigated markets for Pacific bath sponges. Building on this work, an EU-funded project is supporting village-based farming operations with the aim of producing sufficient quantities of sponges to allow a realistic assessment of the market potential in New Zealand to be evaluated. Through mini projects, local farmers and aquaculture officers in a number of countries have now been trained to collect and/or breed and culture species such as Nile tilapia, indigenous freshwater prawns, anguillid eels and sponges. Fisheries officers also increased their skills in a wide range of areas including feed formulation, feed management, mabe (half pearls) pearl production, survey techniques, water quality monitoring and data recording.

Another aspect of the WorldFish program involved capture and culture of pre-settlement coral reef fishes and invertebrates. Initially the methods were developed in the Western Province of Solomon Islands, and they have since extended the techniques to other Solomon Islands' Provinces and also Fiji, Kiribati and Tonga. Following a training workshop, villagers in Western Province are now catching and rearing post-larval tropical lobster, cleaner shrimp and fish which they sell to a Honiara-based aquarium fish exporter. Training workshops have been held in Fiji, Kiribati and Tonga. In Fiji a village has been identified with high potential for successful adoption and community members fully trained. Although not at commercial stage yet, the University of the South Pacific is assisting with developing the fishery. Fisheries officers in Kiribati and Tonga also now have the basic skills to determine if the methods have potential for them.

Also in Tonga the winged pearl oyster, *Pteria penguin*, is traditionally used for production of mabe pearls for export market to Japan and elsewhere. This oyster species was introduced to Tonga in 1975 and at the end of 2000 there were 25 small pearl farms. A major impediment to the sustainability and expansion of the pearl industry in Tonga is a reliable and adequate supply of oysters. Over recent years, poor recruitment of spat has resulted in the harvesting of adult oysters

from the wild, which has further impacted recruitment, and natural spat fall of *Pteria* penguin in Vava'u is now extremely limited. A project is focusing on the development of appropriate hatchery culture techniques for *Pteria* penguin and the use of hatchery-propagated oysters for pearl production. The research will help to optimise culture methodology and pearl production as a basis for sustainable industry development.

Globally, horticulture, including floriculture, has become a lead sector for poverty reduction in developing countries. This, however, has not been the case for the Pacific islands. A scoping study investigated the potential for developing the ornamentals industry in the Pacific. While the study specifically covered Fiji and PNG, much of the findings were seen as relevant for the region as a whole. The study found that Fiji's comparative advantage in ornamental horticulture lies in supplying the non-tourist domestic market, and the industry had made good progress in realising this opportunity. It has been less successful with respect to the tourism segment which offers the most growth potential. Niche export opportunities have been identified for specialty leaves and for indigenous orchids. By contrast PNG offered some outstanding agro-ecological conditions for cut flowers and foliage, but in terms of export market development these advantages were more than offset by intractable marketing and other constraints. It is highly unlikely that PNG could establish a cut flower export industry comparable to that of East Africa and Central America, but a worthwhile cut flower industry could be built around a significant expansion of the domestic market, supplemented by niche export of specialty products.

Evidence from many Pacific island communities suggests that much animal manure accumulates per unit land area, and that lack of proper management of this accumulation can contaminate potable water underground in atolls or in catchments in high islands. Scientists and the people from selected communities are working together to identify practical ways of improving management. A project involving Fiji, Tonga, Tuvalu and Kiribati is leading to improvements for communities in all four countries. In a Tongan village 10 farmers have changed from a free-range extensive system, where pigs roam free in the village and nearby land, to a semi-intensive production system with pigs housed at all times. Farmers, at their own instigation and in association with Ministry of Agriculture staff, are already developing ways to improve the way they feed their confined pigs and developing improved health programs. In

Tuvalu there is potential for a positive impact on the environment as farmers change the design of their piggeries as well as their waste management. In both Fiji and Kiribati farmers have begun to use animal waste as compost in vegetable gardens. There are potential economic gains in all communities through substitution of organic manure for expensive fertilisers, and farmers have also noticed improved soil structure.

A feasibility study has considered initiatives to develop and progress the production of tropical fruits in Tonga. Given its favourable climatic and physical conditions and its relative abundance of suitable land, Tonga would appear to have a comparative advantage in tropical fruit production. The country's geographic position relative to New Zealand and Australia is also an advantage. But the study highlighted the number of subsistence and part-time growers that presently dominate the tropical fruits sector in Tonga, and the lack of diversification of tropical fruits and markets. Given its low productivity levels, there is significant scope to increase the production of the Tongan fruit industry. Some key priorities identified in the study were to improve the prospects of fruit production by introducing new fruit species, replace fruit imports where appropriate, and to develop exports of fruit. But future success depended on capacity building and community engagement.

The search is also on for integrated control of powdery mildew and other disease, weed and insect problems of squash in Tonga. A 2007 field trial for controlling powdery mildew on squash using fungicides suggests there is no resistance to currently available fungicides in Tonga. The GRAS (generally regarded as safe) chemicals tested in Tonga and Australia show consistent effectiveness for the control of powdery mildew of squash. A recommendation will be made on the cost to the Tongan and Australian markets on incorporating GRAS chemicals into the spray schedule, reducing the reliance on fungicides. Another success has been to test the effectiveness of growing a cover crop of *Mucuna pruriens* (velvet bean) on weed suppression. Crops planted in 2006 and again in 2007 have proven beneficial in controlling weed populations while

increasing economic returns from squash cultivation.

Livestock production is an important economic activity in Tonga with 80 per cent of households keeping livestock. Major issues restraining the development of a commercial pig and poultry sector are the lack of a local feed manufacturing industry, the high cost of imported feed and the importation of relatively cheap pig and poultry meat, mainly from Australia, New Zealand and Canada. A project aiming to establish a local feed manufacturing industry hopes to implement some approaches developed in other South Pacific countries and in Indonesia. Three livestock farmers and a government scientist undertook a 10-day study tour to Solomon Islands and Papua New Guinea in August, 2007. Following the study tour all the project partners met in Tonga and agreed to develop suitable feeding systems for pigs and poultry in Tonga, based on what they had observed on the tour. The use of cheaper local feed in the alternative feeding systems could lead to an expansion of the smallholder egg, chicken meat and pork sectors, with these farmers making a significant contribution to the meat requirements of the country.

Subprogram 2: Sustainable management of forestry and fishery resources

A project seeks to address key issues relating to the **acceptance of coconut wood** into the high-value flooring market. Activities are focusing on development of processing systems and profiles for high-quality flooring, and establishment of appropriate grading standards, product specifications and quality control systems. Project leaders and technical staff conducted several initiation meetings and visits to facilities and palm plantations in Fiji and Samoa. They continue to build a network of interested parties and conduct trials with in-country participants. Project staff delivered a training workshop for cocowood primary processing (supported by The Crawford Fund) in Fiji during September. A project website 'cocowood' <www.cocowood.net> launched in February delivers information and news about the project and encourages communication between industry, research and other stakeholders. A network comprising industry contacts in Australia, Fiji and Samoa, including flooring market and production specialists, potential resource suppliers and processors, is now in place.

A good start has been made on two projects that are designed to **underpin good silvicultural practice** in the emerging high value plantation

timber industries of Vanuatu and the Solomon Islands. The species involved are whitewood (*Endospermum medulosum*) in Vanuatu and teak (*Tectona grandis*) in particular in Solomon Islands. In both cases, the objective is to develop silvicultural protocols that are compatible with local agroforestry practices. This will involve interplanting with a fast-growing pole species, *Flueggea flexuosa*, in the Solomon Islands, and intercropping with agricultural and horticultural species in Vanuatu.

The particular challenge for another project has been to assist remote rural communities to develop and adopt **sustainable resource use practices for sea cucumber** (harvested for commercial purposes) in an environment where there is often poor understanding of the relationship between fishing pressure and future harvests, where processes for negotiating shared management responsibilities are not well developed, and where there are few alternative sources of income to meet their few, but important, monetary needs. The Government-imposed moratorium on the harvest or export of beche-de-mer (processed sea cucumber) from December 2005 to May 2007 provided the project team with the opportunity to work closely and at length with one community, Kia, in Isabel Province, to provide training and workshops, and to assist the community to draft its management plan for the sea cucumber fishery. The process of 'hastening slowly' has led to impacts well beyond the target community with the Kia community resource management plan leading to development in 14 other coastal communities, along 140 km of coastline. The Kia marine resources management plan has been officially implemented and project-trained villagers are carrying out the monitoring that will feed back into the management practices, using principles of adaptive management. A similar approach was adopted in a village cluster on the west coast of Vella Lavella, in the Western Province. The next steps will focus on scaling out this work to coastal communities throughout Solomon Islands in a follow-on ACIAR-funded project, with the Ministry of Fisheries and Marine Resources and FSPI (a regional non-government community-focused organisation) as partners.

Subprogram 3: Biosecurity and pest and disease management

A forestry project aims to reduce the risk of serious damage to the valuable timber resources of Fiji, Vanuatu and Australia from exotic pests by **establishing efficient detection systems** in high hazard sites. Some major target pests are the cedar shoot caterpillar, wood and bark beetle pests of pines and hardwoods, lepidopterous defoliators, guava rust and *Erythrina* gall wasp. Since an initial workshop in 2006 country participants have undertaken static trapping surveys. Although there have been difficulties through a combination of theft/damage, poor preservation of specimens in the traps and personnel changes, the surveys have yielded specimens that have been positively identified. One of these was of quarantine significance – the Asian ambrosia beetle (*Xylosandrus crassiusculus*).

Ginger farming is an intensive horticultural system practiced in Fiji and Australia.

Strategies to control soil-borne pathogens of ginger are under investigation. Scientists believe that central to control of nematodes, as well as the fungal pathogens *Pythium* and *Fusarium*, is to create conditions that suppress pests and diseases by increasing soil microbial activity and diversity and improving soil nutrition. Preliminary results from Australian field and glasshouse experiments have shown that carbon inputs from plants and amendments improve the biological status of soils while excessive tillage and fallowing have a negative impact. Suppression of root-knot nematode and to a lesser extent *Fusarium* was enhanced by amending soil with poultry manure/sawdust, and by reducing tillage.

Both large and smallholder farmers in the Pacific islands grow brassicas, mainly head cabbage, Chinese cabbage and watercress, but their crops are frequently **infested with diamondback moth**. The use of insecticides is the main form of control, but integrated pest management (IPM) approaches to diamondback moth used elsewhere in the world have limited insecticide use while maintaining control. A trial conducted at Sigatoka research station in Fiji tested a preliminary IPM strategy against current farmer practice and control (no intervention) treatments. The experiment showed that IPM effectively managed the pest complex of diamondback moth and large cabbage moth, promoted natural enemy activity and resulted in crop yields which equalled yields achieved by farmer practice. A refined version of the preliminary IPM strategy will be tested in both Fiji and Samoa in the 2008 growing season.

Subprogram 4: Farming systems economics and marketing

A project has attempted to empirically assess the economic and environmental impacts of agricultural trade liberalisation on the Fijian economy, as well as the environmental effects of increased agricultural production and trade. In one study the research team calculated that the **economic cost of soil degradation** to cane farmers and the sugar industry was an estimated US\$8 million per annum, while the industry also lost about US\$12 million in sugar sales per annum. Despite the high economic cost of land degradation to farmers and the significant external costs it imposes on society in general, soil conservation was very low on the government's policy agenda. The project team recommended a more comprehensive study of the issue of land degradation prior to developing policies to address the problem.

Nurturing horticulture opportunities were the driver for a unique collaborative venture between the Queensland Department of Primary Industry and Fisheries and the Samoan Ministry of Agriculture and Fisheries. The project is benefiting both indigenous communities in Cape York Peninsula and in Samoa with reports of increased production of horticultural products among both the communities. The project was designed with twin objectives in mind: to foster the **sustainable development of horticulture to supply local and distant markets** and to enhance capacity for the development and use of technical information by researchers, extension personnel and farmers. It began with identifying the current information constraints to horticultural industry development for remote communities, the key commodity interests for each community and progressed through to production of a range of grower information on production, marketing and cultivar identification, harvesting and grading as well as a series of health and nutrition factsheets (for 18 food crops including taro, papaya, bananas) for growers and consumers and extension staff in Samoa and other Pacific countries.

6.3 The good oil on sandalwood

As a result of very high prices available for quality heartwood, natural populations of several species of sandalwood (*Santalum* spp.) have been heavily exploited in many countries of the Asia–Pacific region. In most areas, harvesting levels have been well above those that are sustainable. This is the case in Vanuatu, where many populations of *S. austrocaledonicum* are heavily depleted due to over-harvesting.

But recent ACIAR-funded studies, headed by James Cook University in Cairns, give cause for hope that sandalwood agroforestry could be developed as a commercial opportunity for both communities in Vanuatu and indigenous communities of Cape York. In both study areas the scientists have discovered that 3–4 per cent of local sandalwood tree populations possess exceptional oil qualities. These qualities exceed the industry standards set by Indian sandalwood (a different species), making them a valuable resource for the domestication of the species. Until now neither the Cape York nor the Vanuatu species were thought to have trees of this quality.

The project team has embarked on sandalwood domestication projects in Cape York and Vanuatu. The team had a breakthrough in developing techniques of vegetative propagation that offer opportunities for the rapid development of superior cultivars. This new discovery opens a way for local communities to make a greater contribution to the sandalwood industry through planting of these superior varieties, which would then be expected to produce some of the highest quality sandalwood oil in the world.

The project established a ‘host’ trial in Port Vila (sandalwood is a root parasite and must have a host of another species). Species under trial are *Canarium indicum*, *Casuarina equisetifolia* and *Pterocarpus indicus*. Ni-Vanuatu project participants received instruction in sandalwood plantings establishment, nursery establishment and procedures, sandalwood propagation, plantation establishment and plant improvement.

For a small nation such as Vanuatu, a significant sandalwood plantation estate obviously could make a major contribution to the national economy. It is evident, however, that there is a window of opportunity – if Vanuatu establishes a significant area of successful plantations over the next few years, it will capture the opportunity to ride the wave of high prices; if it delays, then the opportunity will be lost to others. The priority in Vanuatu is therefore to stimulate and promote rapid development of the planted sandalwood industry.

Recognising this, a new ACIAR project is under development, focusing on maximising the adoption of outputs from the earlier project research. It will include the development of a promotion strategy, which will include technical extension material and a prospectus document outlining the investment potential for sandalwood plantings in Vanuatu.

By supporting the development of community sandalwood agroforestry this project can potentially result in positive social, economic and environmental benefits to the people of Vanuatu. Such a move also paves the way for a similar undertaking by indigenous communities in north Queensland.

These activities are significant for the Australian sandalwood oil industry, which stands to benefit through future access to a consistent supply of the high quality oil necessary for producing premium branded products.

6.4 Projects concluded in 2007–08

Project number	Project title	Page
ADP/2002/047	Trade liberalisation, agriculture and land degradation in Fiji: implications for sustainable development policies	74
AH/2001/054	The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific	76
CP/2000/044	Taro beetle management in PNG and Fiji	78
FIS/2001/036	Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks	80
FST/2006/118	Sandalwood inventory	81
HORT/2001/023	Horticulture industry development for market-remote communities	83
HORT/2006/055	Developing the ornamentals industry in the Pacific: an opportunity for income generation	85

ADP/2002/047: Trade liberalisation, agriculture and land degradation in Fiji: implications for sustainable development policies

Summary

Export-oriented growth is a key to the sustainable long-term development of the Fijian economy. In the medium-term much of this growth is expected to come from agriculture, a sector where Fiji has comparative trade advantages. Agriculture has contributed the bulk of total exports and almost a fifth of GDP, but both these contributions are in decline.

Trade liberalisation is driving some agricultural growth and could become an important driver of sustainable development. But there is a danger that the impacts of increased production could harm Fiji's fragile ecosystem. Land degradation resulting from cultivation on steep slopes and marginal lands, combined with deforestation on these and other lands, are already causing problems. The availability and quality of freshwater is being affected and biodiversity is being lost. Land and sea-based pollution are also rising.

These areas of concern for the Government must be balanced against the potential for trade liberalisation to drive development. Policies are needed to strike this balance, ensuring benefits are gained from trade liberalisation while maintaining effective environmental resource conservation measures. But the key institutions in Fiji responsible for developing and implementing these policies have little experience in these areas.

This project sought to empirically assess the economic and environmental impacts of agricultural trade liberalisation in Fiji, as well as the agricultural production and trade effects of environmental changes, and to propose measures to mitigate any adverse impacts. The specific objectives were to:

- assess the impact of trade liberalisation policies on agricultural production, the economy and the environment, with particular emphasis on land degradation, biodiversity etc.
- critically review the institutional framework required to make trade, environment and agricultural policies more effective as drivers of sustainable development

- collaborate with and build USP and National Planning Office (NPO) staff capacity in economics research, with particular reference to trade policy analysis and environment–economy modelling;
- communicate the findings to the stakeholders and the academic community through technical and non-technical publications
- model the effects of climate change on agricultural output and the economy.

Project Information

Overseas Collaborating Countries: Fiji

Commissioned Organisation: University of Queensland, Australia

Project Leader:

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Collaborating Institutions:

- University of the South Pacific, Fiji
- Ministry of Finance and National Planning, Fiji
- Australian Bureau for Agricultural and Resource Economics, Australia

Project Budget: \$394,677

Project Duration: 01/10/2003 to 31/12/2007 (Project extended from 01/10/2006 to 31/12/2007)

ACIAR Research Program Manager: Dr Simon Hearn

Project outcomes

A computable general equilibrium (CGE) approach, supplemented with a series of partial equilibrium (econometric) studies, was adopted to investigate the impacts of agricultural trade liberalisation. The investigation of environmental effects in this study was limited to land degradation, in particular soil erosion. The main findings are as follows:

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Land degradation

A first attempt was made to quantify the economic cost of soil degradation to cane farmers and the sugar industry. The team estimated the cost of soil erosion to farmers at about US\$8 million per annum, while the industry losses in sugar sales per annum were gauged at about US\$12 million.

Despite the high economic cost of land degradation to farmers and the significant external costs it imposes on society in general, soil conservation rated very low on the government's policy agenda. At the institutional level, there is weakness in implementing and enforcing environmental legislation, while at the farm level there is lack of government support for education and extension services.

Sugar production is not the only area where land degradation is a problem; for example, soil erosion is also high in the cultivation of ginger. Therefore, there is a need to take a comprehensive look at the issue of land degradation and to institute policies to address the problem.

Trade liberalisation

The project team analysed and compared various trade liberalisation scenarios beginning with unilateral trade liberalisation by Fiji and including different types of regional trade agreements (RTAs), global trade liberalisation, as well as various options for structural reform of the Fiji economy.

While various RTAs could yield some overall benefits, the best outcome for Fiji is global trade liberalisation involving removal of tariff and non-tariff barriers between the developed and developing countries. To successfully meet the impending challenges brought on by trade liberalisation, Fiji would need to restructure its agriculture sector (especially the sugar sector) and expand its export base. Targeting a particular sector for growth is likely to have adverse impacts on other sectors. Therefore, broad diversification of the economy would deliver the best outcomes for the economy. For this to be possible there is a need to address the institutional and structural constraints that inhibit producers' ability to react to favourable market conditions.

Key recommendations

The project team advocates increased government expenditure to improve public education and awareness about land degradation. As well, there appears to be lack of awareness in the general community about the effects of trade liberalisation. Information put out in the local media by anti-trade organisations depicts trade liberalisation as having adverse effects on the economy. However, the project research indicated that the net benefits can be positive. There is therefore a need for more public education on this issue.

There is a need for the Government to harness both internal and external resources to address structural and institutional constraints such as poorly developed transport and telecommunications infrastructure, inadequate ports and handling facilities, tedious customs procedures, lack of marketing networks, lack of knowledge about standards, lack of microfinance programs, and poor functioning of markets for leasehold land. The Government also needs to invest in human capital development, with specific emphasis on low- and middle-level skills training.

Based on feedback received from workshop participants and on the team's own observations, the ability of government agencies to conduct policy analysis is vital to effective decision-making. However, this is one area where capacity is grossly lacking, even in a country like Fiji where educational levels are relatively high compared to other Pacific Island Countries. Therefore, there is a need for more initiatives such as this one to build capacity within government agencies.

The modelling approach used in this study could be extended to investigate the links between the economy, the environment and poverty, further enhancing understanding of these complex relationships and helping to propose more effective poverty alleviation programs.

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

Summary

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

Trichinellosis, leptospirosis and angiostrongylosis are the diseases of most concern in the region. Leptospirosis infection causes production loss in livestock and is a serious public health issue, especially for owners of livestock and workers in the processing industry. *Angiostrongylus cantonensis* infection is an unquantified threat to livestock health and is emerging as a serious public health problem. *Trichinella* infection in pigs is a barrier to livestock trade and could result in a significant loss to producers. If this organism entered Australia, it could cause severe economic losses to the Australian pork industry.

Project Information

Overseas Collaborating Countries: Fiji, Kiribati, Papua New Guinea, Tonga

Commissioned Organisation: Murdoch University, Division of Veterinary and Biomedical Sciences, Australia

Project Leader:

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Collaborating Institutions:

- National Agriculture Quarantine and Inspection Authority, Papua New Guinea
- Secretariat of the Pacific Community, Fiji
- University of Melbourne, Australia
- Children's Hospital, Westmead, Australia
- Department of Agriculture, Fisheries and Forestry, Australia

- WHO/FAO/OIE Collaborating Centre for Reference & Research on Leptospirosis, Australia

Project Budget: \$555,579

Project Duration: 01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)

ACIAR Research Program Manager: Dr Doug Gray

Project outcomes

This project was designed to extend the outputs of AS1/2001/054 'The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific', which was reviewed in 2005. The review of AS1/2001/054 highlighted the main scientific achievements of the project in the: development and validation of antibody-detection ELISAs for *Trichinella* and leptospirosis; development of a sensitive PCR-based test to detect pathogenic species of *Leptospira* in urine and kidneys of livestock in the Pacific region; establishment of serological diagnostic capability at the NVL for these organisms; improved epidemiological knowledge about leptospirosis infection in cattle in PNG; findings in Fiji which indicate human leptospirosis may involve atypical hosts; confirmation of wider distribution in PNG of *T. papuae* than previously thought.

The research adoption approaches to extend the earlier work were to:

- undertake surveys of cattle to determine the economic benefits to be gained by controlling leptospirosis through the use of vaccinations
- undertake surveys in villages to determine the epidemiology and public health significance of leptospirosis
- determine if the PNG commercial pig herd was free from *Trichinella* infection
- determine the prevalence of zoonotic infections caused by *Trichinella*, *Leptospira* and enteric protozoa in livestock in Kiribati.

The major benefits to be gained from this project are in improvements to the productivity of beef cattle through the development and application of control

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programs for leptospirosis. This should lead to increased incomes for smallholders as they access an increasing market for their cattle. Knowledge of the public health significance of zoonotic infections is important because it provides information that can be used to prioritise scarce resources.

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

Summary

Taro is the preferred staple in Pacific communities. One of its main pests is the taro beetle, which damages the corm (an underground stem resembling a bulb) of the plant and creates entry points for secondary pests. The taro beetle causes about 30 per cent yield loss in taro-producing countries such as PNG and Fiji. Taro production is a labour-intensive crop which is grown on a small scale in farming communities. The spread of the taro beetle in the Pacific is a threat to taro exporters and their revenue, and it also has an environmental impact because farmers abandon infested taro gardens and move on to clear established forests for new gardens.

For Australia, the use of fungi such as *Metarhizium* as mycoinsecticides is attractive because fungi are specific, natural and often give persistent control in the soil. However, the use of mycoinsecticides in Australia has been slow because of the lack of suitable products and the high costs. To improve this situation, more research is needed for better understanding of strain selection, mass production, formulation and application strategies. Better control practices would reduce taro beetle damage in farmers' fields, restore the supplies of taro as a major staple and revive the trade in quality taro in infested countries.

This project aimed to develop biological controls for the taro beetle, and also investigated the combined action of pesticide control and bio-control. It aimed to implement any new methods for taro beetle management in environmentally sustainable cropping systems in Papua New Guinea (PNG) and Fiji.

Project Information

Overseas Collaborating Countries: Fiji, Papua New Guinea

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

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Collaborating Institutions:

- CSIRO Entomology, Australia

- Ministry of Agriculture, Sugar and Land Resettlement, Fiji
- National Agricultural Research Institute, Papua New Guinea

Project Budget: \$853,855

Project Duration: 01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)

ACIAR Research Program Manager: Dr T K Lim

Project outcomes

In total ACIAR provided six years of project funding (four years for research and two years for participatory research) for the management of taro beetles in Papua New Guinea and Fiji. The commissioned organisation, Secretariat of the Pacific Community (SPC), also used funds from the European Union's project on 'Plant Protection in the Pacific' to extend the activities in Kiribati, New Caledonia, Solomon Islands and Vanuatu, countries also facing menace of the taro beetles.

Taro beetles in the two ACIAR project countries caused losses of up to \$A40 million in PNG and about \$FJ1 million in Fiji. In Vanuatu and Solomon Islands it was virtually impossible to grow taro without beetle damage. In Fiji, taro growing for commercial purposes shifted to outer islands to get quality taro for export. This increased production cost and transportation problems. In PNG, taro growing was only possible by clearing new land from virgin forests.

In the first four years of the project, the project team conducted extensive laboratory and field experiments to evaluate bioagents and insecticides; these were selected from the Pacific Regional Agriculture Project, where initial studies had been done but no conclusive results obtained.

The results of these studies showed that *Metarhizium anisopliae* (Ma) when applied to soil in the taro planting holes gave about 30% of the marketable yield of taro corms. Although, the beetle mortality rates were high due to Ma infection, the infected beetles took longer to be killed. As a result damage to corms still occurred. Insecticides imidacloprid when applied to soil in the planting holes at the time of

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planting and three months after planting resulted in marketable yields of taro corms of up to 90%. Bifenthrin applied in the same way as imidacloprid also gave similar results. Imidacloprid used in low dosages with Ma also gave good control of the beetles, but not as high as when used alone. Residue analysis was also conducted which showed no trace of Bifenthrin in harvested taro corms. Imidacloprid was recorded below maximum residues levels in harvested corms.

Based on these results the team drew up recommendations on dosages levels, frequency and methods of application of the insecticides imidacloprid and bifenthrin and safety in their use, and other taro-growing practices. These were demonstrated to taro growers at Farmer Field Schools in PNG, Fiji, Vanuatu and Solomon Islands. The synergy on low dosages of imidacloprid with Ma was also demonstrated to taro growers. The taro beetle management package of practices was developed and launched at field days in PNG, Fiji and Vanuatu.

The project results are bringing confidence in taro growing communities in PNG, Fiji, Vanuatu and the Solomon Islands. There has been an increase in the sale of the recommended insecticides and more taro is now growing in the beetle-infested areas. Growing of taro on flat lands and repeated plantings are now possible, reducing the clearing of virgin forests for taro plantations. Quality taro can now be produced for food and as a cash crop with returns for the taro growers.

The project found an interim solution to the beetle menace, but further work is needed to gain a long-term solution for this persistent pest. The evaluation of new and effective insecticides with lesser environmental effect needs to continue. Other studies needed include evaluation of pheromones, which can play a vital role in dissemination of the *Oryctes virus* (Orv). Laboratory studies have shown that the virus is very effective in controlling the beetle and can be used in inaccessible areas of the beetle breeding grounds. Evaluations of plant-derived pesticides are also recommended. It is believed that before the advent of pesticides, farmers were using plant extracts to manage taro beetles in their plantations. Cultural practices used by farmers can be harnessed and put together with the modern approaches of pest control into a 'holistic' pest management practice for taro growers.

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

Summary

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

A bioeconomic model (developed in an earlier ACIAR project) of the Pacific tuna fishery has been used by the Forum Fisheries Agency and the Secretariat of the Pacific Community to identify and analyse various concerns associated with increased purse seine catching. One of the negative impacts identified is that increased purse seining reduces catch of larger (older) and higher priced tuna caught by longliners and sold fresh. A second concern identified with the model is that the traditional method of charging the purse seine fleets of distant water fishing nations for access to the EEZs of the Western and Central Pacific Ocean is not maximising the flow of annual rents from tuna harvesting to island nations. A third issue is that excess vessel capacity has built up in the fleets that harvest the tuna, which has led to economic inefficiencies in harvesting.

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

Project information

Overseas Collaborating Countries:

Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu

Commissioned Organisation: La Trobe University, School of Economics, Australia

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Collaborating Institutions:

- University of Queensland, Australia
- Secretariat of the Pacific Community, New Caledonia
- Forum Fisheries Agency, Solomon Islands

Project Budget: \$577,584

Project Duration: 01/01/2002 to 31/12/2007 (Project extended from 01/01/2006 to 31/12/2007)

ACIAR Research Program Manager: Mr Barney Smith

Project outcomes

Final report not yet submitted by the project leader.

FST/2006/118: Sandalwood inventory

Summary

Continued high demand and over-exploitation of the natural resource base of sandalwood (*Santalum*) species has led to a shortage of sandalwood oil on the international market. Recent field studies in Vanuatu and Cape York Australia have discovered that a small proportion of trees (3-4%) in local sandalwood populations possess exceptional oil qualities, even better than Indian sandalwood. This new discovery opens the prospect for local communities to produce highest quality sandalwood oil.

There are currently limitations on sandalwood harvest in Vanuatu, but the Vanuatu government is concerned that wild stocks may be exploited. Characterising sandalwood (*Santalum austrocaledonicum*) abundance in Vanuatu is challenging due to the broad, discontinuous yet highly modified distribution of sandalwood and the lack of systematic historical inventories or detailed harvest documentation. This study undertook a rough census of the country's wild sandalwood stocks to provide scientific underpinning for a conservation strategy.

Project information

Overseas Collaborating Countries: Vanuatu

Commissioned Organisation: James Cook University, School of Earth and Environmental Sciences, Australia

Project Leader:

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Collaborating Institutions: Department of Forests, Vanuatu

Project Budget: \$84,475

Project Duration: 01/04/2007 to 30/09/2007

ACIAR Research Program Manager

Dr Russell Haines

Project outcomes

The preliminary distribution had been estimated from anecdotal ranges provided by the Vanuatu Department of Forests (VDoF), GIS spatial analyses and recorded sandalwood locations collected during an Oil Quality Survey

in 2005, and during the 2007 sandalwood inventory survey conducted for this project.

Historic densities have been estimated from anecdotal descriptions and harvest data records. Current densities are based on the 2007 field survey of sandalwood populations on four Vanuatu islands. The surveys were conducted in regions of known sandalwood populations. The low aggregated density (0.4 trees/ha) of commercially sized trees found in these surveyed populations is a cause for concern. The survey scientists recommended extending the current survey to Tanna and perhaps northern Santo islands.

Based on the field data, they estimated that the current resource on the four islands surveyed is approximately 210 tonnes, with another 80 tonnes on other islands of Vanuatu. At current harvest rates this resource may be quickly depleted and there would be a shortfall until plantation sandalwood is available in 10-15 years. They believed that the quota for wild sandalwood harvest needed reducing to a sustainable level. This would entail implementing two purchase registers that clearly record purchases of heartwood and sapwood as separate products. The further development of this monitoring system may be a suitable activity for government or overseas assistance.

There is a need for accurate and ongoing sandalwood growth and yield data, based on several islands to cover the range of genetic types present. Ideally these growth data should be collected annually at permanent quadrats. Measurements of tree height, diameter at breast height (DBH), basal area at 10-cm height and identification of host species should be made using standard forestry techniques.

There is also a need for systematic recording and archiving of harvest data within the VDoF. Ideally this would be regularly sourced from the buyers and recorded on a standard proforma. The data could be stored both electronically and in hard copy, and analysed regularly with some form of reporting.

The survey scientists supported the initiatives of the VDoF and industry to promote plantation establishment on several islands. This will also take harvest pressure away from wild populations of

Concluded projects

sandalwood, which currently need protection from over-harvesting and from damage by cattle grazing and trampling. They found that size class distribution over the entire survey area was skewed towards very small seedlings/suckers and saplings. Even at the best sandalwood sites there was a lack of mature trees and the distribution of stem sizes was likewise heavily skewed. The remaining trees occurred in small clusters and density per hectare was very low.

They suggested that the sandalwood genetic resource should be conserved using ex-situ seed conservation techniques. This might be carried out in the private sector as an adjunct to the wider establishment of sandalwood plantations. They also recommended that VDoF investigate the feasibility of establishing an effective network of sandalwood conservation agreements to conserve representative populations and genetic resources over the species' range in Vanuatu. This might be in exchange for support for plantation establishment.

The implementation of a planted resource survey, to quantify the extent and maturity of both small holder and investment plantings, would help determine the most appropriate planting models for different economic objectives. The scientists recommended the establishment of sandalwood growth plots in conjunction with progressive sandalwood farmers, to quantify the long-term productivity of different planting models across different climatic and edaphic zones.

They also saw opportunity for further refinement to map suitable sandalwood habitat across Vanuatu that accommodates both climatic variables and environmental tolerances. Variables such as proximity to transport corridors and ports should also be considered when determining areas suitable for more significant investment in planting sandalwood.

HORT/2001/023: Horticulture industry development for market-remote communities

Summary

Remote tropical communities undertaking horticultural activities must carefully choose what enterprises they invest in, with particular focus on the distance of these communities from markets. Where infrastructure is poor or non-existent only produce with a longer shelf life and good chance of surviving to market can be grown. Perishable commodities will not survive and reduce or destroy profitability. Technical research has made advances in improving both pre- and postharvest management of a variety of horticultural produce. Many of these have positive implications for shelf life, making up for under-developed supply chains and also enhancing development of these chains. Quality management systems are of great importance, generating improved practices and efficiencies throughout the supply chain.

Information packages are the key to delivering these improvements, and to the industry's long-term sustainability. They can help remote communities such as those in Samoa and Cape York Peninsula in Australia to make the right choices of what fruits to grow and how to deliver improvements to the supply chain. The problem of insufficient access to relevant information is common to many remote communities in both developed and developing countries. The methodology adopted in this project will be applicable in other communities in both developed and undeveloped areas.

This project was designed to foster the sustainable development of horticulture in Samoa and on Cape York Peninsula to supply local and distant markets, by enhancing capacity for the development and use of technical information by researchers, extension personnel and farmers.

Project Information

Overseas Collaborating Countries: Samoa

Commissioned Organisation: Queensland Department of Primary Industries and Fisheries, Australia

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Collaborating Institutions: Ministry of Agriculture, Forests, Fisheries and Meteorology, Crops Division, Samoa

Project Budget: \$499,874

Project Duration: 01/07/2003 to 31/12/2007 (Project extended from 01/01/2007 to 31/12/2007)

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

Although the project locations in both countries had similarities they also showed diversity, providing confidence that the project methodology can apply broadly across the Pacific and to other areas of the world with limited information sources on tropical horticulture.

In Samoa, project cooperators included the growers of commercial crops, the sellers of produce and those involved in value-adding to local produce as information end-users, together with staff of MAF including researchers, advisors and information officers, staff of other government and non-government institutions with similar aims as information providers.

In Australia, project cooperators included individuals and administrators of various Aboriginal communities on Cape York Peninsula, particularly Mapoon Community and commercial growers and support agencies in the Cooktown area.

Information analysis was conducted through a rapid rural appraisal (RRA) using card sort techniques, semi-structured interviews and focus group discussions, together with participatory rural appraisal (PRA) activities comprising 52 interviews and farm visits, eight meetings and two PRAs with participants from the four target groups in Samoa.

Semi-structured and Card-sort interviews were conducted with 89 people in Mapoon, Napranum, Weipa, Lockhart River, Coen and Cooktown during 17 visits to the Peninsula and Cooktown. In addition, there were two visits by Cooktown and Peninsula growers to southern production areas, two focus group meetings were held with commercial growers in the Cooktown area, and a public presentation day was conducted in Mapoon.

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Capacity building for Samoan staff included four workshops on information product development and six visits to information and crops marketing locations in Australia.

Over 100 publications and 12 editions of the project newsletter were produced. More significantly, the ability to produce such items is retained and used in Samoa and the knowledge of information sources and an ability to research these sources is retained in the Cooktown and Peninsula Communities.

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

Summary

There is enthusiasm for cut flowers in the main towns of most Pacific Island countries, but floriculture as an industry is very much in the developmental stage, and focuses on the local market. The primary aim of this project was to evaluate the market opportunities that exist for a thriving floriculture industry in two Pacific Island countries – Fiji and Papua New Guinea. The project also sought to identify the main constraints (for example, pests and diseases, limited skill levels, poor quality, limited packaging and storage technology) that would hinder the development of the floriculture industry in the two countries, and make recommendations to address the constraints.

Project Information

Overseas Collaborating Countries: Fiji, Papua New Guinea

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader:

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Collaborating Institutions:

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- South Seas Orchids, Fiji
- Mary Elzs Orchid In Bloom Ltd, Papua New Guinea

Project Budget: \$96,300

Project Duration: 01/01/2007 to 31/12/2007

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

Globally, horticulture (including floriculture) has become a lead sector for poverty reduction in developing countries. This, however, has not been the case for the Pacific Islands where horticultural and floricultural exports are miniscule.

While this scoping study specifically covered Fiji and PNG, much of the findings have relevance for the region as a whole. The economic contributions of the Fiji and PNG floriculture industries are small. However, in

the case of Fiji the industry generates livelihoods for a significant number of people.

Fiji's comparative advantage in ornamental horticulture lies in supplying the domestic market. While the industry has made good progress in realising this opportunity with respect to the non-tourist domestic market, it has been less successful with respect to the tourism segment which offers the most growth potential. Niche export opportunities have been identified for specialty leaves and for indigenous orchids sold in compliance with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This study recommended institutional reforms to facilitate the realisation of these opportunities.

Although PNG offers some outstanding agro-ecological conditions for cut flowers and foliage, in terms of export market development these advantages are more than offset by intractable marketing and other constraints. It is highly unlikely that PNG would be able to establish a cut-flower export industry comparable to those of East Africa and Central America. However, a worthwhile cut flower industry could be built around a significant expansion of the domestic market, supplemented by niche export of specialty products. PNG has the potential to establish a major commercial indigenous orchid industry exporting unique hybrid plants and expanding eco-tourism activities. This hinges on addressing regulatory and policy reforms pertaining to CITES.

A number of potential activities were identified for ACIAR/SPC involvement in the development of ornamental horticulture in the Pacific islands.

Fiji:

- red ginger decline research
- the development of a *Gardeners Guide to Fiji's Native Plants*
- the development of a pilot 'Fiji Flowers' quality assurance and certification scheme
- a review of Fiji's quarantine regulations and procedures relating to floriculture

Concluded projects

- the development of cost-effective quarantine treatments for ornamentals.

PNG:

- policy development for minor forest products
- an adult education program development for ornamental horticulture and floral art
- technical advice on the establishment of a wholesale marketing system
- a feasibility study for the re-development of the Lae National Botanical Gardens
- industry organisation development.

A number of the recommended future activities are regional in nature. These are:

- developing a policy framework for Melanesian countries to progress with the sustainable commercial development of non-timber forest products
- a framework for indigenous orchid hybridisation
- technical support for tertiary institutions in the development of ornamental horticulture skills.

7 Impact assessment program

ACIAR has always had a significant investment in impact assessment (IA), which is part of the Policy Linkage and Impact Assessment program (PLIA). The purpose is to provide an important after-the-event dimension to the comprehensive monitoring and evaluation processes ACIAR has had in place for many years. These processes are used to ensure that ACIAR's funds are used to support priority issues and are undertaken so that objectives are achieved efficiently and effective impacts result.

The IA functions include an important accountability role in providing key stakeholders with a clear measure of the returns on the funds ACIAR invests. ACIAR continues to expand the measures of these returns to include quantification of all 'economic' impacts, that is, financial, environmental, social and capacity building/stock of knowledge. In addition the assessments are increasingly providing a basis for improving the research selection process by identifying lessons learnt from past activities and feeding them into the project development and selection process.

Emphasis is also placed on developing collaborative links with partner countries, Australian and international groups undertaking similar activities to enhance ACIAR's effectiveness in this area. These collaborative links help improve the accuracy of the information used in assessing the impacts of the research and also the effectiveness of the methodology used to quantify the returns on investment.

ACIAR currently undertakes two types of impact assessment; adoption studies and detailed full benefit-cost impact assessment studies. Adoption studies are undertaken three to four years after a project has been completed and they involve the project leader reviewing the level of adoption of project outcomes, as well as the impact on the communities. Impact assessment studies are done by external reviews and they measure economic growth and environmental, social and capacity-building impacts. They are usually done on a suite of related projects to look at the full impact of ACIAR-funded research.

7.1 Impact assessments undertaken in 2007–08

In 2007-08 nine impact assessment studies were undertaken. Seven were finalised and reports published. The other two are being finalised and will be published in early 2008–09. These results demonstrate that the returns on ACIAR and its partners investments are very high. In total the programs and projects assessed have been shown to have returned a net present value of \$2.3 billion in welfare gains from the investments. Some of the investments have shown extremely high rates of return with benefit to cost ratios of up to 250:1 and internal rates of return up to 210 per cent.

We have continued to focus on quantification of capacity building impacts. The study on pig improvement in Vietnam specifically focused on this and continued to demonstrate that this is an important aspect of ACIAR's partnership modality. Two dimensions were again identified. The first is the contribution the capacity building makes to enhancing the impact of the technology specifically developed by the research. The second is the longer term impact the enhanced capacity has on future activities and investments; this was again shown to be a significant source of welfare

gains from the R&D. Several other studies considered the capacity building impacts but it was found that if the elapsed time since completion of the project had not been long enough, it was too early to reliably identify the subsequent impacts.

Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts

The impact assessment (IA) found that the net present value of the benefits to all funding is \$1,988.3 million with \$1,105.5 million attributable to the original ACIAR and partner funding and the balance to the other funders of subsequent development activities. The rates of return to this ACIAR activity were estimated as a benefit to cost ratio of 257:1 and an internal rate of return of 74 per cent. The study also shows that \$422.7 million of the total \$1,988.3 million benefits are attributable to the capacity building activities developed in the ACIAR- and partner-funded activities.

The impact of increasing efficiency and productivity of ruminants in

India by use of protected-nutrient technology

The dairy sector is an important part of agriculture in India. Productivity of dairy cows is recognised as being relatively low by international standards and feed quality and availability was identified as an important contributor. The adaptation of known protected nutrient technology from Australia to different feeds available in India was the focus of the ruminants research. The assessment estimates that the net present value of the welfare gains from the impact is \$232.1 million. The returns on the R&D investment are estimated as a benefit to cost ratio of 123:1 and an internal rate of return of 44 per cent.

ACIAR fisheries projects in Indonesia: review and impact assessment

This study provides a review of all ACIAR-funded fisheries research in Indonesia and two detailed impact assessment studies – tuna capture fisheries and shrimp aquaculture. For captured fisheries management, the assessment shows that the capacity developed in early projects contributed significantly to Indonesia becoming a member of a regional fisheries management group and to the associated access to high value markets for southern blue fin tuna caught in Indonesian waters. The estimated net present value of the welfare gains from the investments required to achieve Indonesian membership of this regional group is \$1,100 million. The share of these returns attributable to the ACIAR

supported component is assessed to be \$168 million, indicating a return on ACIAR- and partner-invested funds of a benefit to cost ratio of 179:1 and an internal rate of return of 210 per cent.

For shrimp aquaculture the research developed effective technologies for pond remediation. The net present value of the welfare gains from the impact is estimated to be \$547 million with a benefit to cost ratio of 52:1 and internal rate of return of 26 per cent.

A review and impact assessment of ACIAR's fruit-fly research partnerships, 1984–2007

Fruit flies are a major pest in Australia and most of ACIAR's partner countries. ACIAR has invested in several areas of fruit fly research for over 20 years. The review and impact assessment of this major research program found a complex story with a diversity of potential impacts and strong demands on institutional and policy systems to be able to capitalise on research results. The return from the substantial investment by ACIAR and its partner countries is significant with a net present value of \$208.1 million, a benefit to cost ratio of 5:1 and an internal rate of return of 33 per cent. However, these benefits are distributed in a complex manner between the 15 partner countries and Australia.

7.2 Planned impact assessments in 2008–09

- At least five impact assessment studies (IASs) of completed projects will be published. Measurement of economic growth, environmental, social and capacity-building impacts will be incorporated where identified as important and possible.
- Review and publish the 2008–09 project leader adoption studies for the set of large projects concluded in 2003–04.
- Review the application and impact of ACIAR forages research activities and determine the implications of the impacts for future research in this area.
- Undertake an assessment of at least one program of research for at least one significant partner country.
- Collaborate with the Standing Panel on Impact Assessment (SPIA) of the Consultative Group for International Agricultural Research (CGIAR) to undertake a detailed study of the impact of CGIAR research on ACIAR's mandate regions. This study will make use of past CG Centre impact assessment studies and/or undertake some new impact assessments.
- Continue to add to a small database of all past impact assessment studies and start a process of Project Impact Assessment Summaries (PIAS) studies to provide a basis for and complement to the Adoption and Impact Assessment Studies.

Project-specific

Publish five assessments of the impacts of completed projects in 2008–09. Measurement of economic growth, environmental, social and capacity-building impacts will be incorporated where identified as important and possible.

This year we will continue the process of selecting some projects for assessment using a stratified sampling process. The stratification of projects will be based on a range of considerations such as program area, geographic location, types of research and sector of the economy.

Review and publish the 2008–09 project leader adoption studies for the set of large projects concluded in 2003–04.

Capacity building

Develop closer links with partner-country impact assessment groups to enhance estimation of technology adoption levels in future assessments. Training for partner-country impact assessment groups will also be included where appropriate. This training will include collaboration with the ATSE Crawford Fund.

Develop collaboration with international CG 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 the 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, summaries of the implications of impact studies will be provided to meetings of these groups.

Thematic studies

Review the application and impact of ACIAR forages research activities and determine implications of the impacts for future research in this area.

Undertake an assessment of at least one program of research for at least one significant partner country.

Continue to develop a database of all past impact assessment studies and start a process of project impact assessment summaries (PIAS) studies, to provide a basis for and complement adoption and impact assessment studies.

Work closely with the Office of Development Effectiveness (ODE) to ensure ACIAR's impact assessment work maintains close links with ODE's activities.

8 Appendix 1: ACIAR Contacts

8.1 Country Office

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9 Appendix 2: ACIAR Publications

This is a list of ACIAR publications produced in 2007–08. 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	
119b	<i>Guidelines for surveillance for plant pests in Asia and the Pacific [Vietnamese translation]</i> . Teresa McMaugh, Vietnamese translation by Phan Thuy Hien, 2008, 192 pp.
119c	<i>Guidelines for surveillance for plant pests in Asia and the Pacific [Thai translation]</i> . Teresa McMaugh, Thai translation by Yupa Hanboonsong, 2008, 199 pp.
120a	<i>Better-practice approaches for culture-based fisheries development in Asia [Lao translation]</i> . Sena S. Silva, Upali S. Amarasinghe and Thuy T.T. Nguyen, 2008, 105 pp.
120b	<i>Better-practice approaches for culture-based fisheries development in Asia [Vietnamese translation]</i> . Sena S. Silva, Upali S. Amarasinghe and Thuy T.T. Nguyen, 2008, 96 pp.
128	<i>Quality management of fresh produce from the highlands of Papua New Guinea: a postharvest manual</i> . Vincent Haguluha and Ernest Natera, ed. by John Spriggs, 2007, 86 pp.
129	<i>Diagnostic manual for plant diseases in Vietnam</i> . Lester W. Burgess, Timothy E. Knight, Len Tesoriero and Hien Thuy Phan, 2008, 210 pp.
130	<i>Soil Constraints and Management Package (SCAMP): guidelines for sustainable management of tropical upland soils</i> . P.W. Moody and P.T. Cong, 2008, 85 pp.
131	<i>Integrated pest and disease management for sustainable cocoa production: a training manual for farmers and extension workers</i> . John Konam, Yak Namaliu, Rosalie Daniel and David Guest, 2008, 36 pp.
132	<i>TaroPest: an illustrated guide to pests and diseases of taro in the South Pacific</i> . Amy Carmichael, Rob Harding, Grahame Jackson, Sarlesh Kumar, Sada Lal, Roy Masamdu, Jacqui Wright and Anthony Clarke, 2008, 76 pp.
133	<i>Overcoming liver fluke as a constraint to ruminant production in South-East Asia</i> . G.D. Gray, R.S. Copland and D.B. Copeman (eds), 2008, 155 pp.

Proceedings	
126	<i>Integrated rural development in East Nusa Tenggara, Indonesia</i> . S. Djoeroemana, B. Myers, J. Russell-Smith, M. Blyth and E.I.T. Salean (eds), 2007, 196 pp.
127	<i>Permanent beds and rice-residue management for rice-wheat systems in the Indo-Gangetic Plain</i> . E. Humphreys and C.H. Roth (eds), 2008, 192 pp.

Technical Reports	
67	<i>Grassland degradation on the Tibetan Plateau: the role of small mammals and methods of control</i> . Anthony D. Arthur, Roger P. Pech, Jiebu, Zhang Yanming and Lin Hui, 2007, 35 pp.
68	<i>Economic potential of land-use change and forestry for carbon sequestration and poverty reduction</i> . Oscar Cacho, Robyn Hean, Kirsfianti Ginoga, Russell Wise, Deden Djaenudin, Mega Lugina, Yuliana Wulan, Subarudi, Betha Lusiana, Meine van Noordwijk and Ni'matul Khasanah, 2008, 98 pp.
69	<i>Achieving food security in China: implications of World Trade Organization accession</i> . Chunlai Chen and Ron Duncan, 2008, 67 pp.

Working Papers	
59a	<i>A survey of the mineral status of livestock in the Tibet Autonomous Region of China [Mandarin translation]</i> . Nyima Tashi, Luo Xugang, Yu Shunxiang and Geoff Judson, 2008, 36 pp.

Impact Assessment Series Reports	
52	<i>Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts.</i> Hayden Fisher and Jenny Gordon, 2008, 56 pp.
53	<i>The impact of increasing efficiency and productivity of ruminants in India by the use of protected-nutrient technology.</i> Michael Monck and David Pearce, 2008, 32 pp.
54	<i>Impact of improved management of white grubs in peanut-cropping systems in India.</i> Michael Monck and David Pearce, 2008, 34 pp.
55	<i>ACIAR fisheries projects in Indonesia: review and impact assessment.</i> G. Martin, 2008, 75 pp.
56	<i>A review and impact assessment of ACIAR's fruit-fly research partnerships, 1984–2007.</i> Bob Lindner and Paul McLeod, 2008, 164 pp.
57	<i>Management of internal parasites in goats in the Philippines.</i> N.D Montes, N.R. Zapata Jr, M. Alo and J.D. Mullen, 2008, 44 pp.
58	<i>Guidelines for assessing the impacts of ACIAR's research activities.</i> Jeff Davis, Jenny Gordon, David Pearce and Debbie Templeton, 2008, 36 pp.

Final Reports	
2007-01 [AH/2006/164]	<i>Future directions for animal health services in Indonesia.</i> Helen Scott-Orr, Bruce Christie and Tristan Jubb, 2007, 29 pp. http://www.aciar.gov.au/node/3508
2007-02 [FST/2005/049]	<i>Mastotermes darwiniensis in the Lae area of PNG.</i> B.M. Thistleton, M. Neal, M. Peki and J. Dobunaba, 2007, 50 pp. http://www.aciar.gov.au/node/3945
2007-03 [SMAR/2007/229]	<i>Options for teak industry development in South East Sulawesi, Indonesia.</i> S. Midgley, A. Rimbawanto, Mahfudz, A. Fuazi and A. Brown, 2007, 41 pp. http://www.aciar.gov.au/node/3870
2007-04 [PLIA/2007/019]	<i>A review of the future prospects for the world coconut industry and past research in coconut production and product.</i> Bob Warner, Derek Quirke, Chloe Longmore, 2007, 89 pp. http://www.aciar.gov.au/node/3938
2007-05 [SMAR/2007/228]	<i>Improving lobster grow-out and nutrition in West Nusa Tenggara—a feasibility study.</i> Clive Jones, Made Susastika, Fatuchri Sukadi, Arif Surahman, 2007, 23 pp. http://www.aciar.gov.au/node/3946
2007-06 [ASEM/2005/062]	<i>The vegetable industry in the Philippines.</i> P.J. Batt, S. Concepcion, K. Dagupen, M.C. Lizada, R. Murray-Prior, 2007, 63 pp. http://www.aciar.gov.au/node/4189
2007-07 [PLIA/2005/148]	<i>Papua New Guinea coffee and cocoa policy linkages.</i> Derek Quirke, Matthew Harding, Bob Warner, 2007, 74 pp. http://www.aciar.gov.au/node/3940
2007-08 [PLIA/2005/159]	<i>A constraints analysis of mango supply chain improvement in Pakistan.</i> R. Collins, T. Dunne, J. Campbell, P. Johnson, A.U. Malik, 2007, 39 pp. http://www.aciar.gov.au/node/3939
2007-09 [PLIA/2006/180]	<i>Happy Seeder policy linkage scoping study.</i> P. Pagan, R.P. Singh, 2007, 33 pp. http://www.aciar.gov.au/node/5019
2007-10 [SMAR/2007/042]	<i>Vegetable value chains in eastern Indonesia—a focus on chilli.</i> B. White, P. Morey, R. Natawidjaja and W. Morgan, 2007, 73 pp. http://www.aciar.gov.au/node/3943
2007-11 [SMAR/2007/200 – Part 1]	<i>Securing the profitability of the Flores coffee industry.</i> Tony Marsh, Jeff Neilson and Surip Mawardi, 2007, 23 pp. http://www.aciar.gov.au/node/3942
2007-12 [SMAR/2007/200 – Part 2]	<i>Securing the profitability of the Toraja coffee industry.</i> Tony Marsh and Jeff Neilson, 2007, 38 pp. http://www.aciar.gov.au/node/3942
2007-13 [SMAR/2007/209]	<i>The citrus market in Indonesia— an eastern Indonesian perspective.</i> Phillip Morey, 2007, 44 pp. http://www.aciar.gov.au/node/3944
2007-14 [PLIA/2006/012 Part 1]	<i>Livestock health and vaccines in Cambodia and Laos.</i> Matthew Harding, Robert Warner, David Kennedy, 2007, 119 pp. http://www.aciar.gov.au/node/5195

2007-15 [PLIA/2006/012 Part 2]	<i>Cattle and buffalo in Cambodia and Laos: the economic and policy environment for smallholders.</i> Matthew Harding, Derek Quirke, Robert Warner, 2007, 98 pp. http://www.aciar.gov.au/node/5196
2007-16 [ASEM/2001/037]	<i>Improving the marketing system for fresh produce of the highlands of PNG.</i> John Spriggs and Barbara Chambers, 2007, 67 pp. http://www.aciar.gov.au/node/8457
2008-01 [AH/2006/163]	<i>Assessment of zoonotic diseases in Indonesia.</i> Nigel Perkins, Ian Patrick, Mahomed Patel and Stan Fenwick, 2008, 100 pp. http://www.aciar.gov.au/node/6987
2008-02 [LWR/2005/042]	<i>Scoping study to assess the technical and economic feasibility of wheat production in southern Bangladesh.</i> P. Carberry, M. Saifuzzaman, H.M. Rawson, M.A. Sufian, A.B.S. Hossain, N.P. Dalgliesh, 2008, 44 pp. http://www.aciar.gov.au/node/7189
2008-03 [PLIA/2005/151]	<i>Philippine policy linkages scoping study.</i> A.M. Balisacan, S. Cuthbertson, M.A. Sombilla, J. Corbishley, 2008, 44 pp. http://www.aciar.gov.au/node/7051
2008-04 [AH/2005/107]	<i>Food safety research in Indonesia: a scoping study and ACIAR's response.</i> Roger Morris and ACIAR, 2008, 67 pp. http://www.aciar.gov.au/node/7097
2008-05 [LWR/2000/089]	<i>Permanent beds for irrigated rice-wheat and alternative cropping systems in north-west India and south-east Australia.</i> Liz Humphreys, Geoff Beecher, Yadvinder Singh, S.S. Kukal, H.S. Sidhu, Jagadish Timsina, John Blackwell, David Smith, Rajinder Pal Singh, 2008, 69 pp. http://www.aciar.gov.au/node/7190
2008-06 [AH/2006/155]	<i>Vaccine business development in the Lao PDR.</i> David Kennedy, Scott Williams, Stephen Page, Nancy Bourgeois-Lüthi and Richard Bevan, 2008, 139 pp. http://www.aciar.gov.au/node/7316
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