

Country Profile

# **Pacific Island Countries**

**August 2004**

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

© 2004 Australian Centre for International Agricultural Research  
GPO Box 1571 Canberra ACT Australia 2601

ACIAR. *Country Profile: Pacific Island Countries*. August 2004.

ISSN 1449-9460 (print)

Additional copies of this publication are available from ACIAR'S Australian office:

Communications Program Manager

Tel: +612 6217 0500

Fax: +612 6217 0501

Email: [comms@aciar.gov.au](mailto:comms@aciar.gov.au)

Postal address:

GPO Box 1571

Canberra ACT 2601

Website: [www.aciar.gov.au](http://www.aciar.gov.au)

# Contents

Preface	5
Pacific Islands Report 2002–03	7
Pacific Island Countries Plan 2004–05	9
Active projects at 30 June 2004	15
Concluded projects 1 July 2002–30 June 2004	45
Projects under development at 30 June 2004	51
South Pacific consultations	53
ACIAR publications	55



# Preface

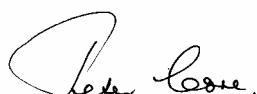
The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of bilateral and multilateral projects with Pacific island countries that were active at 30 June 2004. At that time there were 14 active bilateral projects and two active multilateral projects, the latter being led by an international agricultural research centre. There were another 12 bilateral and one multilateral projects under development, many of which are expected to start in 2004–05.

This publication also sets out the key outputs and outcomes from the two projects that have been completed since July 2002.

In addition to these project summaries, the publication includes an extract from ACIAR's 2002–03 Annual Report covering the Pacific island countries, our near-term program as outlined in the 2004–05 Annual Operational Plan, and a record of the most recent consultations held between ACIAR and Pacific island countries on the medium-term priorities for the joint program.

ACIAR will update this profile each year and distribute it to key stakeholders in the Pacific and Australia.

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



Peter Core  
Director

August 2004



# Pacific Islands Report 2002–03

(extract from ACIAR Annual Report 2002–03)

Number of projects active in 2002–03	15
Bilateral expenditure in 2002–03	\$1 583 522
Bilateral expenditure in 2001–02	\$575 333
Bilateral expenditure in 2000–01	\$1 076 185

## Position

ACIAR's program with the Pacific has grown significantly in the past year, in line with broader Australian official development assistance priorities. A stable and economically viable Pacific is in Australia's interests. There are many factors constraining socioeconomic development of Pacific island countries. The region's small renewable resource subsectors are dominated by subsistence agriculture. Commodity exports are an important income source, as is income gained from fishing resources rents.

Many Pacific island countries have limited capacity to participate effectively in ACIAR's normal mode of bilateral collaborative research partnerships. Their participation in regional or multi-country programs and projects addressing common problems partly helps overcome these constraints. Projects are designed to address risks associated with institutional instability, personal security, high staff turnover and limited depth of national staff resources. ACIAR also supports some collaborations by Pacific island countries with two CGIAR centres, the WorldFish Center and the International Plant Genetic Resources Institute (IPGRI).

## Achievements

A project on Fiji's sugar industry has helped the Government to re-evaluate restructuring options for the Fiji Sugar Corporation. Institutional reforms to improve the efficiency of production to the milling chain are being considered. Another Fiji-based project has used diaries to collect dietary nutrition information. The methodology will be used in the upcoming national nutrition survey to be funded by AusAID. A low-cost food choice model is being developed for use in training nutritionists and educators and for use in policy analysis around the national survey.

Fisheries research is a key part of ACIAR's Pacific activities. With the Forum Fisheries Agency, a bio-economic model, used in the determination of harvest levels and rents payable for the South Pacific tuna fishery, was updated with biological, catch, price and cost parameters. Two potential charging systems for obtaining access fees from Distant Water Fleet Nations fishing in the exclusive economic zones of the Pacific island nations were examined for feasibility and economic efficiency. The project identified that 'charge-on-effort' schemes should be considered, using a formula based on catch parameters and fishing days.

A re-examination of the stocks of coconut crabs in Vanuatu to determine if the management arrangements introduced 10 years ago have been sufficient has shown that significant stocks of crabs still remain. At that time management arrangements were introduced to conserve the remaining stocks that were in danger of being fished out. The study findings, which have been discussed with the relevant Vanuatu Minister, suggest there is reason to be optimistic about the success of the arrangements, but that fine-tuning of management options is still needed. Follow-on research in trochus reseedling has commenced in Vanuatu with a focus on developing a framework for community consultation and participation, stock enhancement on selected reefs, and eventual dissemination of the project results nationally and regionally. The work has been extended to Samoa where it is hoped the establishment of a trochus fishery will provide employment and income-generating opportunities.

In Fiji, following a second introduction of the GIFT Tilapia fish (bred in the Philippines by the WorldFish Center and the GIFT Foundation), fingerlings are being provided routinely at no cost to commercial farmers through government-supported hatcheries. Demand has increased significantly for the fry, and new hatcheries have been developed in other regional areas on the two large islands as tilapia aquaculture has expanded.

In 1998, ACIAR funded the transfer of blacklip pearl oyster spat collection techniques from the Solomon Islands to Fiji. These techniques are being used by Fiji Fisheries to collect spat near Savu Savu to supply a 200 000 shell commercial oyster operation. A successful hatchery and culture facilities for these oysters have also been developed in Kiribati. A demonstration pearl farm has become a focal point for training members of the community and for hosting potential investors. A draft Development Plan formulated during the project will provide a continuing framework for the future development of a cultured pearl industry in Kiribati and address both technical and political issues relating to this development.

Working in close cooperation with AusAID's TaroGen project, an ACIAR project has used genetic fingerprinting to classify the many varieties of taro. Virus indexing was also conducted to ensure safe movement of germplasm between countries. All viruses of taro in the region have now been identified, and reliable diagnostic tests are available for almost all viruses. Genetic fingerprinting of all varieties is complete, and a regional training workshop was held to transfer relevant molecular techniques to South Pacific scientists. An ACIAR-funded plant genetic resources specialist was assigned to the Secretariat of the Pacific Community to help preserve the valuable plant resources of the region. The specialist is aiding in information dissemination of genetic resources of several important Pacific crops, notably taro and breadfruit. A project on yam nutrition in PNG, Vanuatu and Tonga has seen good progress. Yams are one of the most valuable of the Pacific root crops, but are also nutrient-demanding. A database of nutrient deficiency symptoms is being assembled. Tonga has made most progress, demonstrating good response to phosphorus and to mucuna cover crops for yams. Vanuatu is also starting to make progress, with widespread testing during the year.

Modelling and monitoring of the major fresh groundwater resources of Kiribati has demonstrated that a 30 per cent increase in sustainable freshwater extraction is possible in the capital, South Tarawa. This is a significant increase in a country with less than 30L/capita/day of available reticulated freshwater. Analyses of demand and the impact of frequent severe El Niño-related droughts have demonstrated that additional groundwater sources will have to be found for South Tarawa by 2010.

Studies into three zoonotic diseases which can substantially reduce animal productivity are underway in several Pacific island communities. Zoonotic diseases are carried by animals, but are capable of being transferred to humans, with the possibility of transmittal increasing as human and animal populations share the limited land areas often found in the Pacific. Two types of tests to detect the presence of the diseases have been developed and are being refined to allow identification of low-level infections. Information on the prevalence of one of the diseases in trial sites in Fiji has been determined, and the life cycle of the second of the three diseases, including animals involved in passing on the disease, identified.

# Pacific Island Countries Plan 2004–05

(extract from ACIAR Annual Operational Plan 2004–05)

South Pacific countries: Bilateral research expenditure	\$m 2002-03 actual	\$m 2003-04 budget	\$m 2004-05 budget	\$m 2005-06 indicative
Active projects	1.58	1.87	1.16	0.6
Committed funds for new projects			0.42	0.4
Projects under design			0.51	0.7
Available for new projects				0.6-0.8
Total	1.58	1.87	2.09	2.2-2.4

## Strategy

ACIAR's strategy in the Pacific addresses the significant challenges of market development for agricultural and fisheries products including implications of WTO accession, quarantine- and biosecurity-related issues, product quality, scale of production and remoteness of export markets. We will maintain a mixture of research on value-adding and marketing, cash-generating crops, fishing and production sustainability. Projects will emphasise technologies that are appropriate to smallholders, and address institutional issues affecting technology uptake.

ACIAR invests bilaterally in nations of particular importance to Australia – Fiji, Solomon Islands, Vanuatu, Samoa, Tonga, and Kiribati. Pressure on research capability in the region, especially in individual nations, is an ongoing constraint. ACIAR therefore works closely with regional organisations, especially the Secretariat of the Pacific Community (SPC), in setting priorities and executing projects.

## Key performance indicators

- New projects address emerging priorities agreed at formal priorities consultation held in December 2003
- Growth in budget for Pacific islands compared with 2000-2003 levels
- Mini-project concept in fisheries research for development trialled and expanded
- Initiation of three new project/ contract activities in Solomon Islands
- Initial sea cucumber mass release trials completed and hatchery technology transferred to several countries
- Two short-course training activities held to address identified needs

## Position

ACIAR's program with the Pacific has recently grown significantly, in line with broader Australian foreign policy and official development assistance priorities. A stable and economically viable Pacific is a key objective for the region.

Major factors constraining socioeconomic development of Pacific island countries are small size, physical isolation, limited natural resource base, inadequate communications infrastructure, internalisation and aid/remittance dependence of many economies, limited opportunities for commodity exports, lack of competitive ability in trade globalisation, demographic factors including population growth rates, and insufficient well-trained personnel.

The region's small renewable resources subsectors are dominated by subsistence agriculture. Commodity exports include sugar, fruit and vegetables, vanilla, pepper, kava, hardwood logs and lumber, softwood lumber, fish and other marine products; income is also gained from foreign vessel access fees to fishing grounds within each country's exclusive economic zone.

Commodity-based research on crop and livestock breeding and production may be cost-ineffective, and relevant technology can mostly be adapted from research carried out elsewhere.

Pacific island countries, through their small size, have limited capacity to participate effectively in ACIAR's normal mode of bilateral collaborative research partnerships. Their participation in regional or multi-country programs and projects addressing common problems partly helps overcome these constraints.

Projects will be designed to address risks associated with institutional instability, personal security, high staff turnover and limited depth of national staff resources.

ACIAR supports some collaborations by Pacific island countries with international centres, for example the WorldFish Center on village-scale mariculture and reef ranching, and the International Plant Genetic Resources Institute on genetic resources conservation.

### **Indicative priorities**

ACIAR most recently held a formal program of consultation on priorities with representatives of ACIAR's six bilateral partner countries and key regional organisations in Suva in December 2003. The outcomes of this consultation are available on our website at [www.aciar.gov.au](http://www.aciar.gov.au) under Partner country priorities/South Pacific region. Senior ACIAR staff also meet regularly with the SPC, the South Pacific Applied Geoscience Commission (SOPAC) and the University of the South Pacific (USP). ACIAR also attends whenever possible the regular meetings of: Forum Fisheries Agency; Permanent Heads of Fisheries; Heads of Forestry; Permanent Heads of Agriculture and Livestock Production Services; and Regional Technical Meetings of Plant Protection.

In 2004–05, ACIAR will emphasise projects in agricultural economics (including marketing and policy), crop protection and genetic resource utilisation, fisheries, forestry and postharvest technology. Potential areas for future collaboration are:

#### *Crop sciences (emphasis on crop protection, quarantine and postharvest)*

- Identification of quarantine and pest risk issues for specific crop germplasm requiring exchange between countries for conservation and introduction purposes
- Development of integrated crop management packages (specifically for pest, weed and disease control and other quarantine issues) for breadfruit, yam and sweet potato
- Integration of existing knowledge into information packages for bananas and taro
- Facilitation of national adoption of earlier research on pest, weed and disease management (including biocontrol)
- In Tonga, research on environmentally appropriate pest and disease management to maintain the export squash industry

#### *Fisheries and livestock*

- Stock status assessment and management planning for the sustained use of vulnerable inshore fisheries resources, with an emphasis on increased community-level management and co-management approaches
- Economic and marketing analyses of key aquaculture commodities (initial focus to be seaweed) to better inform producer decision-making and to identify opportunities for regional cooperation in marketing and processing
- Regional studies of import risks associated with the movement of live aquatic organisms and the definition of appropriate quarantine measures and strategies
- Investigation of new opportunities for inland aquaculture, including the domestication of promising indigenous species and integration of aquaculture into existing farming systems
- Utilisation of locally available materials (including waste products) to develop cost-effective feed formulations which improve nutrition in pigs, poultry and aquaculture species

#### *Forestry*

- Watershed protection functions and groundwater management in forestry systems
- Domestication of multipurpose trees, including selection of suitable germplasm and silvicultural management
- Sustainable management (and protection from pests and diseases) of high value plantations, including silviculture, harvesting and re-establishment practices
- Value-adding processing of forest products, including coconut wood and lesser-known species, mahogany branch and salvage wood, and use of mobile sawmills for processing
- Control of exotic, invasive plant species in plantation and agroforestry, especially vine and tree species

#### *Agricultural economics*

- Land and water resource use planning for optimal development of agriculture, forestry and fisheries enterprises
- Improved agricultural statistics to develop indicators that measure smallholder/ subsistence contribution to national economies; quantification of the number of farmers producing, levels of household consumption and supply chain linkages
- Marketing research for root crops, taro and cassava to underpin development of a structured supply chain, with emphasis on quality standards, consistency of supply and packaging requirements

- Economic analysis of current and new farming practices, including of alternatives to slash and burn agriculture and organic farming
- Economic analysis of returns and certification issues of current and potential crops or commodities
- Resource valuations and economic analyses of subsistence and commercial fisheries
- Analysis of the economic tradeoffs incurred in moving from access fee arrangements for Distant Water Fishing Nation vessels to domestic allocation of tuna harvests and onshore processing/transshipment requirements

Follow-up activities that enhance the transfer of technology from earlier ACIAR projects will be pursued, and opportunities for greater involvement of NGOs and industry in projects explored. Projects will also endeavour to have a substantial training component, and short-term and postgraduate training opportunities will receive special attention. While the bulk of ACIAR's investment will be in the form of standard collaborative research, development and extension projects, ACIAR will consider additional modalities, including a greater number of small initiatives. These may include support of consultant visits to address small but urgent problems, and follow up from earlier ACIAR-funded projects.

Training priorities, in addition to those offered within projects and through postgraduate degrees, include experimental design and analysis, research management and evaluation, writing for research and extension audiences, the research-extension interface (including farmer participatory processes) and information and communication technologies. In all Pacific partners, but especially in Vanuatu, Solomon Islands and Kiribati, there is a critical need for additional agricultural researchers with postgraduate training.

Although several of the challenges for agriculture, forestry and fisheries are common to most Pacific nations, and much of the ACIAR program in the Pacific is delivered through regional organisations, we recognise that different nations have different priorities and requirements. Pacific island country participation in regional or multi-country programs and projects addressing common problems will be the main project modality, although ACIAR will continue to support a limited number of single country-specific projects on major issues. A statement on strategy and research opportunities for each of the six Pacific countries through which ACIAR operates bilaterally is provided below.

## Fiji

Population	0.8 million
GNI per capita	AUD 3,977

Fiji's poverty is comparatively low, though rural-urban income inequality is an increasing problem. There is a good natural resource base for agriculture, forestry and fishing.

After a period of ACIAR project cooperation in crop and livestock production, a crop protection focus began in the 1990s. There has also been strong past cooperation in fisheries. Agricultural economics and policy research has recently become much more important, with projects on different aspects of trade policy and land management underway.

Fiji hosts the main site of the University of the South Pacific (offering potential for collaboration in economics, development, geography and marine science and for involvement of students), and the bases of the SPC Land Resources Division and SOPAC.

Sugar production is decreasing, and there is the need for development of alternative land uses for agriculture within a sustainable land management framework. We will support selected economic and technical research aimed at developing alternative crops to sugar.

Development of new horticultural crops such as papaya, spice and nut crops and accompanying postharvest technologies and marketing options are being explored, as are new fruit varieties with longer production seasons.

Research opportunities in fisheries may include continued genetic selection of freshwater finfish and giant prawns; sea cucumber and giant clam production; integrated aquaculture in farming systems; and improved feed formulations for finfish and shrimp. More research may be needed on marketing of fisheries products, including seaweed. Some options for forestry cooperation include timber utilisation, including value-addition to mahogany and native species, plantation management and health, and increasing the potential of indigenous forestry species.

## Solomon Islands

Population	0.4 million
GNI per capita	AUD 31,050

Subsistence agriculture and fishing form over 80% of the livelihoods of people. With the recent ethnic conflict, there has been stagnation or collapse in production and export of many commodities. Fish, timber, copra, palm oil and cocoa were major exports, along with some minerals such as gold, but export earnings have collapsed over the last five years. Most Solomon Islanders live in isolated rural communities dependent on subsistence agriculture and intermittent crop and small livestock sales.

ACIAR has a significant number of completed projects in the Solomon Islands, covering culture of a range of fisheries species, marine protected areas, stock assessment and fisheries management policy; farming systems economics; production and diseases of root crops; insect pests; biological control of pests; and forest tree nutrition. ACIAR's program has a strong fisheries emphasis, including economic and technical research to support the industry. ACIAR has a long-term commitment to cooperation with Solomon Islands, but until recently the program has been hindered by a difficult political and security situation.

The loss of field station and laboratory infrastructure in the national agricultural research system (NARS) means that we will collaborate in on-farm research and recognise that NGOs play an important role in agricultural service delivery and we will involve key rural NGOs in our projects. On-farm adaptive work will be a more feasible option under the present conditions.

Income generation initiatives will be important in the broader scheme of recovery in the Solomon Islands, and much of this necessarily needs to be in agriculture, forestry and fisheries. Immediate assistance could include small, short-term technical interventions in areas where ACIAR projects have developed significant expertise elsewhere in the region. It is important to obtain post-crisis data as a basis for priority setting and identification of market opportunities.

Projects could encompass the following areas: assistance with major pest problems affecting the smallholder honey industry; advice on smallholder poultry feeds using local ingredients; analysis of forestry plantation trials; further development of the local *Canarium* nut industry; mariculture species for coastal communities, including sea cucumbers; identification of the factors behind the reported yield decline in sweet potato; major pest problems affecting food security; and technologies for vanilla production.

## Vanuatu

Population	0.2 million
GNI per capita	AUD 1,989

Vanuatu's agriculture sector (along with tourism) remains the main focus of the country's development strategy. The main activities relate to coconut, cattle, cocoa, and timber production, with traditional food production for subsistence and local markets. Smallholders also cultivate peanuts, potatoes, vanilla and peppers. Although Vanuatu is an agricultural exporter the majority of the population is in the subsistence or informal sector.

ACIAR's past program in Vanuatu has emphasised fisheries, crop sciences and forestry. The major partner for bilateral cooperation in Vanuatu is the Ministry of Agriculture, Quarantine, Forestry, and Fisheries (MAQFF), although some strong farmers' associations exist, and linkages with the French Agricultural Research Centre for International Development (CIRAD) and the private sector also provide opportunities.

With horticultural crops, market analysis of crop commodities for identification of niche markets that Vanuatu can fill is required. Crop protection and postharvest technology research to underpin development of horticultural export markets, and assistance with work on efficacy of fruit fly baits and on management of fruit piercing moth, may also be required. We will ensure that earlier ACIAR support for research on root crops in the region such as taro, yam and sweet potato is extended, through production of field guides.

Targeted research to underpin village-level fisheries (including aquaculture) as well as commercial fisheries is also required. Livestock research may be more important in Vanuatu than elsewhere in the Pacific islands. Forest covers almost 40% of the total land area of Vanuatu, and policy and technical interventions for sustainable management of plantations and development of new species of commercial value for both plantations and smallholders are important. In forestry, assistance is needed in the technology for establishing trials to assess growth and potential yields of native species, including sandalwood and *Canarium*.

## Samoa

Population	0.2 million
GNI per capita	AUD 2,615

Samoa has recently had comparatively strong economic growth across a range of sectors, including agriculture. Samoa has reasonable research capacity in agriculture, forestry and fisheries. The Ministry of Agriculture, Forestry, Fisheries and Meteorology (MAFFM) has several research stations and experimental farms. Samoa is also the Agriculture base of the University of the South Pacific, the FAO Subregional Program and the South Pacific Regional Environmental Program (SPREP).

There has been a strong emphasis in the ACIAR program on insect pest management (fruit flies, fruit piercing moth, whitefly and aphids), virus indexing of taro as well as biological control of pests and weeds. Some projects on forest nutrition and health and fisheries have been carried out.

There is expertise in Samoa in germplasm selection of root crops and fruits and in use of tissue culture propagation, with research opportunities in varietal selection of taro, kava and vegetables to enable year-round supply.

Research opportunities include those that underpin the development of exports of high-value horticultural products. This will require technical postharvest work to improve shelf life and transport to underpin fruit exports (breadfruit, papaya, rambutan) and simple processing / value addition of fruit tree and root crops.

Research to assist improvements in niche marketing of commodities, potentially including organic produce, is of importance. This may include identification of alternative extension and information transfer technologies.

In forestry, research opportunities may exist in the areas of: policy incentives for establishment of woodlots; nursery management techniques; forest weeds, pests and diseases; and better utilisation of timbers. Increasing wood yields from sawmilling is a high priority as there is currently significant wastage.

In fisheries, opportunities may include research on stock assessment of inshore resources and community-based approaches to the management of reef fisheries. Technical interventions to underpin the development of community-level village mariculture industries may be needed.

## Tonga

Population	0.1 million
GNI per capita	AUD 2,596

Factors affecting agricultural development include geographical isolation, fluctuations in export markets for Tongan produce, a limited natural resources base and governance structures. Tonga has high natural disaster susceptibility, and limited income generation opportunities for outer islanders.

ACIAR's past program in Tonga has included many disciplines. For crop-related research, future support is likely to be in the area of marketing and postharvest quality improvement. Farming systems is a current emphasis.

Development of markets is an ongoing challenge, although Tonga has developed a successful export trade in pumpkin squashes over recent years. Research on environmentally appropriate pest and disease management to maintain this industry is a priority. Other areas of research emphasis in Tonga include productivity of root crops and vegetables, development of new crops such as coffee and spices, and development of capacity in postharvest technology.

Crop protection including fruit fly management remains a priority, as does better soil and water management for agriculture and other uses.

Development of agroforestry-based farming systems, including tree legumes and fruit trees, is a priority, and is the main focus in forestry, since plantation resources are modest.

Tuna is the main fishery export from Tonga, and together with snapper and aquarium fish is a major export income source. There may be opportunities in the future for research to build on a current AusAID fisheries support project, in areas such as small-scale fisheries, for example of sea cucumber, community-based fisheries management and development of aquaculture systems for commercially important reef species (growout of blacklip pearl oyster, green snails, and trochus).

## Kiribati

Population	0.1 million
GNI per capita	AUD 1,491

Kiribati is one of the poorest Pacific countries, having few natural resources. The small land area leads to a high and increasing population density on some of its atolls and an accompanying risk of environmental damage from agriculture and other human activities.

The large marine area in the country makes fisheries important for export and subsistence and a logical priority for cooperation. Issues such as tuna resource rents are critical for Kiribati, as is the identification of new village-level mariculture opportunities. There are only limited opportunities in other agricultural sectors, although further exploration of these areas will be pursued.

ACIAR's program in Kiribati has had a strong fisheries emphasis. Availability and quality of water for agriculture and domestic purposes is a critical issue. Research to reduce the dependence on imported food crops and on the conservation and use of traditional food crops will link to opportunistic involvement in applied research on crop pests and diseases, including taro beetle, breadfruit fungal rot and biocontrol of spiralling white fly of pawpaw. In livestock, improved local feeds for pigs and chickens are important for food security.

Limited opportunities for recruitment of skilled human resources in Kiribati constrain opportunities for collaboration. The establishment of a new Central Agricultural Research Institute has been proposed, and ACIAR could assist with planning and training support.

### Key program managers

- Dr Ken Menz, Agricultural Systems Economics and Management
- Dr Wendy Morgan, Crop Protection
- Mr Barney Smith, Fisheries
- Dr John Fryer, Forestry
- Dr Greg Johnson, Postharvest Technology

### Country manager (for Solomon Islands)

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

# Active projects

## at 30 June 2004

### Bilateral

ADP/1996/136: Fiji sugar industry: assessing international sugar market reforms and their impacts and defining appropriate responses	17
ADP/2002/047: Trade liberalisation, agriculture and land degradation in Fiji: implications for sustainable development policies	18
ASEM/2001/036: Maximising the economic benefits to Pacific Island Nations from management of migratory tuna stocks	19
AS1/2001/054: The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific	21
CP/2000/044: Taro beetle management in PNG and Fiji	23
FIS/1997/031: Pearl oyster resource development in the Western Pacific	24
FIS/2001/075: Sustainable aquaculture development in the Pacific Islands region and northern Australia	26
FIS/2001/085: Integration of broodstock replenishment with community-based management to restore trochus fisheries	27
FST/2001/045: Development of forest health surveillance systems for South Pacific countries and Australia	29
FST/2002/010: Domestication and commercialisation of multi-purpose indigenous trees and shrubs for food and other products in Papua New Guinea, the Solomon Islands and Queensland: a feasibility study with special reference to <i>Canarium</i> nut	31
LWR/2001/050: Equitable groundwater management for the development of atolls and small islands	32
PHT/2001/023: Horticulture industry development for market-remote communities	35
SMCN/1998/028: Diagnosis and correction of nutritional disorders of yams	36
SMCN/2001/038: Management of animal waste to improve the productivity of Pacific farming systems	38

### Multilateral

CP/2001/068: Technical support for regional plant genetic resources development in the Pacific	40
FIS/1999/025: Optimal release strategies for restocking and stock enhancement of the tropical sea cucumber, sandfish ( <i>Holothuria scabra</i> )	42



## **ADP/1996/136: Fiji sugar industry: assessing international sugar market reforms and their impacts and defining appropriate responses**

<b>Overseas Collaborating Countries</b>	Fiji
<b>Commissioned Organisation</b>	Australian National University, National Centre for Development Studies, Australia
<b>Project Leader</b>	Dr Padma Lal Phone: 02 6125 0093 Email: padma.lal@anu.edu.au
<b>Collaborating Institutions</b>	Fiji Sugar Commission of Fiji Fiji Land Information Council University of the South Pacific (2000–03)
<b>Project Budget</b>	\$502,258
<b>Project Duration</b>	01/01/2000 to 31/12/2004 (Project stalled by May 2000 political coup, recommenced October 2002)
<b>ACIAR Research Program Manager</b>	Dr Ray Trewin

### **Project background and objectives**

The sugar industry is the backbone of Fiji's economy, providing an important source of national output and employment. However, increasing trade liberalisation and international trade reforms pose a threat to the industry, which is currently sustained by preferential access to United States and European markets. In the short term the project is providing the analysis needed to negotiate an alternative trade agreement and identifying options and strategies to help Fiji adjust to the eventual loss of these preferential markets. The goal in the long term is to improve the efficiency, quality and productivity of the sugarcane industry, and to explore alternative uses for land, such as crop diversification.

The original project, which commenced in 2000, was put on hold following political events in Fiji, and recommenced in October 2002 with a substantially reduced scope. The current objectives are to assess the economic viability of sugar cane based farming systems under current and alternative sugar price scenarios; to assess the financial and economic implications from the perspectives of the growers, landowners and the economy of various land tenure options proposed in Fiji; and to evaluate the economic merit and sharing of profits of the current and proposed industry restructure, and identify appropriate institutions that could encourage economic efficiency in the sugar industry.

### **Project progress**

#### **Year 4 (01/01/2003–31/12/2003)**

Harmonisation and validation of data from various sources (Fiji Sugar Commission (FSC), Native Land Trust Board, SIT and soils data) has been completed. Computerisation of the FSC mill data (mill work advice) has been completed, and preliminary FSC mill efficiency analysis was undertaken.

Geocoding of about 70% of farms has been completed. The rest cannot be done either because the farms have not been surveyed or, if surveyed, the results are not available. Land use classification for each farm has been completed. This information will be used in the econometric analysis once the validated farm survey data is available.

The farm economic survey is completed for two of the four mill areas (the remaining two mill areas were to be completed in January 2004). A detailed analysis of milling performance and farmer performance has been completed, and key areas of efficiency gains that the industry needs to target have been identified.

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

<b>Overseas Collaborating Countries</b>	Fiji
<b>Commissioned Organisation</b>	University of Queensland, Australia
<b>Project Leader</b>	Dr John Asafu-Adjaye Phone: 07 33656539 Email: j.asafu-adjaye@economics.uq.edu.au
<b>Collaborating Institutions</b>	University of the South Pacific, Fiji Ministry of Finance and National Planning, Fiji Australian Bureau for Agricultural and Resource Economics, Australia
<b>Project Budget</b>	\$390,841
<b>Project Duration</b>	01/10/2003 to 30/09/2006
<b>ACIAR Research Program Manager</b>	Dr Ray Trewin

### **Project background and objectives**

The impacts of trade liberalisation in Fiji's agriculture sector, important both economically and as a food producer, are not yet fully understood. Fiji's ecosystem is fragile, easily converted to agricultural uses and vulnerable to climate change. The project is supporting policy decisions on sustainable development through an analysis of trade liberalisation impacts on agriculture, the economy and environment, especially land degradation and biodiversity. Potential climate change impacts are also being analysed, and a review of institutional frameworks relating to sustainable development policy is being conducted. The results are being used in economic modeling and communicated to key Fijian stakeholders to build capacity in policy development for sustainable agriculture.

### **Project progress**

First progress report is due in late 2004.

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

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

### **Project background and objectives**

Shoals of tuna migrate through the exclusive economic zones (EEZs) of island nations in the Western and Central Pacific Ocean. This migratory characteristic means that no nation has control over the tuna stocks. Stocks in each EEZ depend on harvesting levels in each respective EEZ and on the high seas as well, thus each nation has special problems in managing harvesting effort within its EEZ. The member nations of the Forum Fisheries Agency (FFA) stand to gain the greatest total benefit if they unite to regulate fishing effort or catches by their domestic fleets or by distant water fishing nations. As well, the United Nations Fish Stocks Agreement seeks to set up Regional Fisheries Management Organisations for the conservation and efficient management of migratory stocks.

Against this policy background, this project is identifying and promoting strategies for Pacific Island Nations to maximise the economic benefits from their migratory tuna stocks. Researchers are gathering fishery data and undertaking economic analysis, bioeconomic modelling and policy development. They are updating biological and economic parameters of a model in order to use it for optimal year-by-year changes in access charges and fleet capacities. They aim to establish the economic negotiating positions of Pacific Island Nations (PINs) with rights to migratory tuna stocks, and of the Distant Water Fleet Nations (DWFNs) such as Japan, USA, South Korea, Taiwan and China interested in paying for access to the stocks.

### **Project progress**

#### **Year 2 (01/01/2003–31/12/2003)**

An important model being used in the current project for modelling optimal harvesting decisions of the DWFNs is a bioeconomic model developed in a previous ACIAR project (ADP/1994/005: A bioeconomic analysis of tuna purse seining in the Pacific Islands region). In 2003 updating of technical and economic parameters continued as planned, and revised harvesting policies for different tuna species obtained. A technical paper on revised prices and costs, titled 'Tuna Prices and Fishing Costs for Bioeconomic Modelling of the Western and Central Pacific Tuna Fisheries' was released. A website was built to enable easy access to this and subsequent papers, and to present the aims of the project and the contact details of the project participants. The website has attracted overseas interest.

Solution times for the bioeconomic model are relatively long, for two reasons—the first is the detail in modelling the seasonal migration of tuna in the Western Central Pacific Ocean between 5 degree squares, and the second is the very basic algorithm used for obtaining optimal solutions. Because the algorithm simulating optimal negotiation requires many runs of the model, there is the need for a faster, albeit less detailed, model. As planned, work continued in 2003 to develop a smaller, more aggregated model using a different solution process. The large model will be necessary for calibrating

parameters in the smaller model. Work also started on reprogramming the large model to obtain solutions with the new optimising routine.

The special problem of obtaining international agreement on efficient management of migratory fish has been recognised in the United Nations Fish Stocks Agreement. This has led to establishment of commissions to oversee the conservation and management of migratory stocks in various parts of the world's oceans. When the project proposal was written in 2001 it was expected that a commission would be set up for the management of the migratory tuna stocks in the Western and Central Pacific Ocean. After a series of annual preparatory conferences, held since 2000 and involving the PINs and DWFNs affected, the Commission is to be convened in December 2004. The formation of the Commission should focus attention on the benefits of coordinated action by the PINs to improve efficiency in managing stocks.

A key question remains: What measures should be introduced to reduce the overexploitation of yellowfin and bigeye tuna by purse seine and longline vessels? The updated bioeconomic model is being used to study this question.

## **AS1/2001/054: The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific**

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Papua New Guinea, Tonga
<b>Commissioned Organisation</b>	Murdoch University, Division of Veterinary and Biomedical Sciences, Australia
<b>Commissioned Organisation</b>	Dr Simon Reid Phone: (08) 9360 7423 Email: sreid@central.murdoch.edu.au
<b>Collaborating Institutions</b>	National Agriculture and Quarantine Inspection Service, PNG Secretariat of the Pacific Community, Fiji University of Melbourne, Australia Children's Hospital, Westmead, Australia Department of Agriculture, Fisheries and Forestry, Australia WHO/FAO/OIE Collaborating Centre for Reference & Research on Leptospirosis, Australia
<b>Project Budget</b>	\$399,670
<b>Project Duration</b>	01/01/2002 to 31/12/2004
<b>ACIAR Research Program Manager:</b>	Dr John Copland

### **Project background and objectives**

In some Pacific island countries zoonotic diseases (diseases that can be transmitted to humans from animals) are becoming a problem as a result of increasing human and animal density. This project is studying three zoonotic infections (trichinellosis, leptospirosis and angiostrongylosis) that have the potential to cause severe animal production loss and impact human health. The project is developing the capacity for effective surveillance of *Trichinella*, *Leptospira* and *Angiostrongylus cantonensis* infection in livestock in the Pacific Islands. It is also determining the prevalence of *Trichinella*, *Leptospira* and *A. cantonensis* infection in livestock in Fiji and Kiribati and the risk factors associated with their transmission identifying the species of *Trichinella* present in Fiji and Kiribati, and investigating how diseases arise from *T. papuae* in pigs and from *A. cantonensis* in ruminants. The findings of the project will be used to formulate a regional education and control program for zoonotic diseases and to establish a network on zoonoses.

### **Project progress**

#### **Year 2 (01/01/2003–31/12/2003)**

An ELISA test was successfully developed for *Leptospira pomona*. This ELISA has now been standardised for use in cattle and pigs. The results from testing serum collected cattle on Numundo Farm in PNG show that the test has good agreement with the standard serological test and that it had high specificity. Further work is required to test sufficient samples from PNG to determine the diagnostic sensitivity and specificity compared to the standard test. The test is now in a format suitable for transfer to partner laboratories.

A two-day workshop on diagnostic techniques for *Trichinella* infection was held at the National Veterinary Laboratory (NVL) in PNG.

Results of a retrospective serological survey of 479 people living in the Balimo area showed that the prevalence of infection with *Trichinella* of 29.5%. Antibody prevalence did not differ according to sex but there was a significant difference between age groups, and also appeared to differ significantly according to geographic region and age. These results (and those from other surveys) show that *T. papuae* is probably widely distributed in wild pigs (the most likely source of infection for humans) in the south coastal area of PNG at least as far east as Gulf Province.

At the NVL, examination of muscle digests from 31 pigs and 15 rats from the Goroka area found no evidence of *T. papuae*.

Following the discovery of *Trichinella zimbabwensis* in crocodiles in Zimbabwe AQIS has required PNG to confirm freedom from *Trichinella* infection in its crocodile meat exported to Australia from Mainland Holdings Crocodile Farm in Lae. A total of 112 samples of crocodile muscle have been tested at the NVL from captive bred and wild-caught animals. The majority of wild-caught crocodiles originate from the Kikori area (n=52) in Gulf Province. Sixteen of the 52 (30.8%) samples of meat taken from crocodiles from Kikori contained *T. papuae* larvae.

Surveys to determine the prevalence and identity of infecting *Leptospira* serovars began in 2003. Results of a cross-sectional survey of breeding cattle on Numundo Beef (West New Britain Palm Oil) show that there is a high prevalence of *Leptospira* infection in cattle older than two years of age and that the predominant infecting serovars were *hardjo*, *pomona*, *swajizack* and *medanensis*. These data confirm that active *Leptospira* infection exists in cattle herds in PNG and may be a factor in the infertility observed in cattle in PNG.

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

<b>Overseas Collaborating Countries</b>	Fiji, Papua New Guinea
<b>Commissioned Organisation</b>	Secretariat of the Pacific Community, Fiji
<b>Project Leader</b>	Dr Mick Lloyd Phone : +679 3387996 Email : mickl@spc.int
<b>Collaborating Institutions</b>	CSIRO Entomology, Australia Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Agricultural Research Institute, PNG
<b>Project Budget</b>	\$711,309
<b>Project Duration</b>	01/01/2002 to 31/12/2005
<b>ACIAR Research Program Manager</b>	Dr Wendy Morgan

### Project background and objectives

This project builds on work supported over a number of years by the European Union (through the Secretariat of the Pacific Community). The 4-year Taro Beetle Management program commenced on 1 January 2002, as a component of the SPC Pest Management in the Pacific (PMP) program. PMP is one of the two major projects of SPC-Plant Protection Service funded jointly by Australia (AUSAID and ACIAR) and New Zealand (NZAID). Project scientists are completing several research aspects from the earlier project, in preparation for implementation of practical control of taro beetle in two South Pacific countries (PNG and Fiji). They are developing ways to increase the effectiveness of controlling taro beetle grubs through the use of the fungal pathogen *Metarhizium anisopliae* and the viral pathogen *Baculovirus oryctes*. They are also developing sustainable methods for taro beetle control with minimal use of chemical pesticides. Further studies are developing protocols for synergistic combination of chemical pesticides and use of biological control agents to achieve optimum control. Results will be provided to taro growers in the partner countries through participatory implementation approaches in association with SPC extension services.

### Project progress

#### Year 2 (01/01/2003–31/12/2003)

Sodium metabisulphate is now used to sterilise culturing media, and rice has been found to be a suitable substrate for the low-cost production of *Metarhizium (Ma)*. This method of *Ma* production is promising but this needs to be evaluated further before the technology is transferred to farmers. Storage of *Ma* also needs to be studied so the shelf life of spores can be extended.

The technical progress in 2002 and 2003 was reviewed at the 3rd Taro Beetle Management Technical Coordinators Meeting (May 2003) and at the 4th Taro Beetle Technical Committee Meeting (November 2003) in Fiji. The following progress was noted: three field trials were planted in PNG to select appropriate doses of *Metarhizium* for application; six field trials were planted in Fiji.

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

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Solomon Islands
<b>Commissioned Organisation</b>	James Cook University, School of Marine Biology & Aquaculture, Townsville, Australia
<b>Project Leader</b>	Dr Paul Southgate Phone: (07) 47815 737 Email: paul.southgate@jcu.edu.au
<b>Collaborating Institutions</b>	Ministry of Fisheries & Marine Resources Development, Kiribati Ministry of Fisheries and Forestry, Fiji Ministry of Fisheries, Tonga WorldFish Center, Malaysia
<b>Project Budget</b>	\$728,961
<b>Project Duration</b>	01/01/1998 to 31/08/2004 (Project extended from 01/01/2001 to 31/08/2004)
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### Project background and objectives

The black pearl oyster (*Pinctada margaritifera*) flourishes in atoll lagoons and is a major export earner for French Polynesia and the Cook Islands. This ACIAR funded follow-up project involving Tonga and Kiribati, as well as linked pilot pearl farm activity with the WorldFish Centre (ICLARM) in the Solomon Islands, aims to further develop and refine grow-out and pearl culture techniques for this oyster. In Kiribati, investigations include nursery, juvenile and adult culture methods suitable for atoll and open reef systems, the development of a Pearl Industry Development Plan for Kiribati, and pilot community level pearl production trials. In Tonga, where the earlier spat collection study proved disappointing, the focus is on hatchery production of spat, nursery and early grow-out experiments.

### Project progress

#### Year 6 (01/01/2003–31/12/2003)

The major highlight of project research during 2003 was the first harvest of cultured pearls at the Demonstration Pearl Farm at Abaiang in Kiribati. Continuing success in hatchery production of blacklip pearl oysters in Kiribati has supported expansion of project activities at the Demonstration Farm and at satellite farms on other islands in the Gilbert Group (Abemama, Butaritari, Onotoa). Spat collection trials have now been established at Kiritimati Island (Christmas Island). A hatchery run was conducted in Tonga in November/December 2003. Resulting spat will be graded in early 2004 and used for the establishment of experiments documenting growth rate and investigating optimal culture conditions in Tonga. Preliminary growth rate data for *P. margaritifera* spat produced in an earlier hatchery run in Tonga have been generated. Growth rates in Tonga compare well to growth rates recorded at other sites within the Pacific for *P. margaritifera*.

Progress against the three major research objectives of this project extension is summarised below.

#### 1 Development towards a cultured pearl industry in Kiribati

The first harvest of cultured pearls from Kiribati took place at Abaiang in August 2003. About 200 pearls were harvested and a further 4000 oysters were grafted for pearl production. Appraisal of the pearls was undertaken by Mr. Rudy Zingg of Devino P/L (Sydney).

An experimental cultured pearl farm has been established at Tebunginako at Abaiang atoll. About 2000 pearl oysters are housed at the farm, which is maintained by three local people who have previously been trained in pearl oyster culture methods at the Demonstration Pearl Farm at Abaiang.

Spat collectors were first established at Kiritimati Island in July 2003. A second longline with other collectors was established in August 2003. Both longlines were deployed and are maintained by MNFRD staff based at Kiritimati. Some pearl oyster recruits were recorded from spat collectors towards the end of 2003. However, these are still to be positively identified as *P. margaritifera*.

Longlines were established at Abemama, Butaritari and Onotoa in mid-2003. Pearl oysters were deployed to Butaritari and Onotoa at the end of June 2003 and to Abemama in September 2003. Each of the three islands has a 60 m longline (Butaritari has 2 lines) holding between 4000 and 5000 oysters. Growth rates of oysters at Butaritari and Onotoa have been excellent. Oysters were deployed with a dorso-ventral height (shell length) of 5–8 mm. By the end of 2003, they had reached 50–60 mm in shell length.

A draft Cultured Pearl Industry Management and Development Plan was developed through the Pearl Oyster Coordinating Committee (POCC) during 2003. The committee has been approved by Cabinet and will provide advice to the Minister on the development of a cultured pearl industry in Kiribati. The plan will be amended during the project on the basis of project outcomes.

## *2 Production of *P. margaritifera* spat through hatchery culture in Tonga*

The first hatchery run conducted in Tonga in 2001 resulted in a significant number of spat. Unfortunately, many of these died as a result of Cyclone Waka in 2002. Surviving spat were used for limited growth trials begun in 2002 which have provided data on the growth rates of *P. margaritifera* juveniles under culture conditions in Tonga. More extensive growth trials will be conducted in 2004 with spat resulting from the most recent hatchery run conducted in November/December 2003.

Hatchery production of *P. margaritifera* spat was conducted in Tonga in November/December 2003. Unfortunately, unusually low water temperatures (22–25°C) resulted in an extended larval life. While *P. margaritifera* larvae would normally be expected to complete larval development in about 18–20 days, larvae were not removed from culture tanks into settlement tanks until Day 37. Nevertheless, the extended larval period provided good opportunity for training of local staff. Four local fisheries staff and a member of the Pearl Oyster Cooperative from Vava'u were trained in methods related to hatchery culture and feeding of pearl oysters. Approximately 50,000 larvae survived to be placed into settlement tanks, however, the number of spat produced will not be known until spat collectors are harvested in early 2004.

## *3 Production of up to date culture manual for *P. margaritifera**

New information relating to spat collection, spat identification, oyster cultivation and pearl quality has been written into the Culture Manual produced during the earlier project (FIS/1991/031). This process will continue as more relevant information comes to hand. The document will be completed by the end of 2004. Literature relating to pearl quality and oyster cultivation gathered from Polynesia and other sources with assistance from SPC, has also been included.

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

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Northern Fisheries Centre, Cairns, Australia
<b>Project Leader</b>	Dr Mike Rimmer Phone: 07 4035 0109 Email: Mike.Rimmer@dpi.qld.gov.au
<b>Collaborating Institutions</b>	Secretariat of the Pacific Community, New Caledonia WorldFish Center, New Caledonia
<b>Project Budget</b>	\$762,855
<b>Project Duration</b>	01/01/2004 to 31/12/2006
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

Fisheries resources are important in the Pacific Islands, but require sustainable management. Aquaculture has considerable potential to alleviate pressures on fisheries, assist with and enhance food security and provide income and employment opportunities. The disease-free, good-quality waters, combined with low labour costs make aquaculture a potential success in Pacific communities. Northern Australia also shares many of the characteristics of unrealised aquaculture potential. The project team is working with the Secretariat of the Pacific Community (SPC) and Pacific communities to identify and implement targeted research extending the outcomes of past ACIAR and WorldFish Center projects. Post-larval fish capture and culture, and sea cucumber production and reseeding are focal points. Through these and related activities the technical and research skills of partner institutions will also be enhanced.

### **Project progress**

First progress report is due in early 2005.

## **FIS/2001/085: Integration of broodstock replenishment with community-based management to restore trochus fisheries**

<b>Overseas Collaborating Countries</b>	Samoa, Vanuatu
<b>Commissioned Organisation</b>	Kimberley Aquaculture Aboriginal Corporation, Australia
<b>Project Leader</b>	Dr Chan Lee Phone: 03 9670 0354 (in Vic) Phone: 08 9193 7138 (in WA) Email: clee8777@bigpond.net.au
<b>Collaborating Institutions</b>	Department of Agriculture, Forests, Fisheries and Meteorology, Samoa Fisheries Department, Vanuatu Department of Fisheries, Western Australia, Australia
<b>Project Budget</b>	\$396,863
<b>Project Duration</b>	01/07/2002 to 30/06/2005
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

Earlier ACIAR research has shown that it is feasible to use broodstock seeding of marine sites as a tool to replenish populations of trochus. Community involvement is essential for successful restocking with broodstock and this new project will employ community-based management strategies to extend and apply the results of the earlier research. Communities and researchers from Australia, Samoa and Vanuatu are attempting to enhance the trochus populations on selected reefs owned by communities in their respective countries. The ultimate goal is to provide a simple framework that allows the agencies responsible to implement a nationally coordinated and strategic stock management plan for establishing sustainable trochus fisheries through broodstock reseeding, the application of customary marine tenure (CMT) and/or the establishment of marine protected areas (MPAs).

### **Project progress**

#### **Year 1 (01/07/2002–30/06/2003)**

##### *Establishing a framework for community consultation and involvement in enhancement activities*

In Australia, initial meetings were held in September and December 2002, between trochus fishers, traditional reef owners, the Bardi Council and Gudumul outstation, the project leader and the Australian community coordinator, and identified areas that were socially relevant to the project. At these meetings negotiations were held to close the reefs involved in the project to trochus fishing for the duration of the project. Four research sites in King Sound were selected, with reefs designated for seeding and control.

In Samoa, the broodstock seeding and site selection activities commenced in January 2003. Prior to this project, the country has a well established community based fisheries resource management program. After consultations with communities, three sites for broodstock seeding, from the 51 declared MPAs, were selected. The sites are Papa-i-Puleia (on Savaii Is.), Tafitoala and Saleapaga (on Upolu Is.).

In Vanuatu, preliminary contacts with communities were established through national radio announcements inviting interested communities to be involved. Between July and December, 2002, project staff met with and finally selected the communities to be involved. The three seeding sites are in the Malampa (Malekula Is.), Penama (Pentecost Is.) and Shefa (Epi Is.) provinces. All sites have depleted trochus stocks.

*Conducting broodstock enhancement field trials and verifying success of broodstock seeding*

In Australia, four hundred broodstock trochus were collected, tagged, measured and stocked into corrals on each selected seeding reef. Prior to enhancement in August, adult and juvenile census areas were identified on all reefs, permanently marked and surveyed for trochus density. The second density survey scheduled for the year was completed in March 2003. Overall, there was little change in the density of trochus on the sites over this period.

Due to difficulties in getting broodstock from Fiji (as trochus are not endemic in Samoa) only one site was stocked in Samoa; the other two sites will be stocked with broodstock as soon as they are available.

Four hundred broodstock were collected, tagged and released into corrals at each of the three Vanuatan sites.

Field survey and site selection training was conducted for the Samoan project staff. Evaluation done during the first annual project meeting showed that communities in all three research nodes of the project were highly supportive of the broodstock trials and the concept of using CMT and MPAs to sustain the fishery.

## **FST/2001/045: Development of forest health surveillance systems for South Pacific countries and Australia**

<b>Overseas Collaborating Countries</b>	Fiji, Samoa, Tonga, Vanuatu
<b>Commissioned Organisation</b>	Queensland Forest Research Institute, Australia
<b>Project Leader</b>	Dr Ross Wylie Phone: 07 3896 9781 Email: Ross.Wylie@dpi.qld.gov.au
<b>Collaborating Institutions</b>	Ministry of Agriculture, Sugar and Land Resettlement, Fiji Ministry of Agriculture and Forestry, Tonga Secretariat of the Pacific Community, Fiji Forestry Tasmania, Australia Department of Forests, Vanuatu Ministry of Agriculture, Forests, Fisheries and Meteorology, Samoa CSIRO Entomology, Australia Fiji Pine Ltd, Fiji Melcoffee Sawmills, Vanuatu Vanuatu Department of Agriculture, Horticulture and Quarantine Inspection Service, Vanuatu
<b>Project Budget</b>	\$399,509
<b>Project Duration</b>	01/07/2002 to 31/12/2004
<b>ACIAR Research Program Manager</b>	Dr John Fryer

### **Project background and objectives**

Damage by pests and diseases causes major loss of productivity in natural forests and plantations. Forest Health Surveillance (FHS) systems are a mechanism to protect investment in managed forests through early detection of problems, both indigenous and exotic. This ACIAR project addresses the urgent need in Fiji, Tonga, Vanuatu and Samoa for structured pest detection and management. However, appropriate systems for this region are lacking and there is limited capacity and experience to carry out the work. An adaptive research approach, involving partner countries and Australia, is being used in the development and application of their own FHS systems. Key components are development of methodologies for systematic surveys for particular forest types, pest identification and management, curations, rearing/culturing, and data storage and management, supported by access to a network of experts. The project addresses training and specialist networking through workshops and on-the-job instruction to increase country capacity.

### **Project progress**

#### **Year 1 (01/07/2002–30/06/2003)**

Damage from pests and diseases is a major cause of loss of forest productivity in both natural forests and plantations. Forest Health Surveillance (FHS) systems provide a mechanism to protect the substantial investment in plantations and other managed forests through early detection of pest and disease problems, both indigenous and exotic. The underlying principle is that early detection of a pest problem allows more scope for its management. South Pacific nations have limited capacity and experience in regard to forest health and forestry quarantine issues. This project aims to address that need, providing training in surveillance methodologies and recognition of symptoms of tree disorder, determining priority forest pests and diseases and establishing a support network of relevant experts.

The project commenced in November 2002 with a workshop of Australian participants to develop surveillance methodology that is appropriate for use in the Pacific and a simple and operationally easy recording form. The methodology that was adopted is a modification of that used by FHS units in Queensland and Tasmania for plantation and woodlot survey and for surveillance of port surrounds. A Pacific Forest Health Field Form was also developed for use by project personnel during forest

surveys in each country. This was designed to be compatible with the existing SPC Pest List Database (PLD) for the Pacific that will be used to store data collected during this project. It includes some additional forestry-specific fields that have now been accommodated in the PLD.

At a training workshop held for all project collaborators in Suva 31 March to 3 April 2003, the draft methodology was discussed and refined. Group field surveys were then conducted and training provided in FHS techniques, including the use of Global Positioning Satellite equipment, recognition of symptoms of tree disorder, specimen collecting, data recording and entry. Participants were also given an introduction to insect taxonomy and the identification of types of insect and fungal damage to trees. Instruction was provided in methods of specimen handling, curating, shipping and housing. Priorities were formulated for purchase of equipment that is to be used in the setting up of a small, forest health facility in each country. Collecting equipment, reference literature and insect identification keys were distributed to participants for use in each country.

After the April workshop, pest and disease surveys commenced in Fiji, Vanuatu, Samoa, and Tonga. These were carried out by teams comprising Australian FHS specialists and staff from the collaborating country organisations plus, on some surveys, a taxonomist. For each country, the surveys were conducted across a range of plantation tree species, provenances, ages, geographic locations, site conditions and time of year using standardised data collecting methods. Further joint surveys were carried out later in 2003. Also post-workshop, Australian taxonomists inspected insect reference collections associated with forestry, agriculture or quarantine in each country with the aim of assessing capacity and needs. Aspects assessed included the size and condition of the collections, housing, databasing/ cataloguing, equipment, staffing, and taxonomic support. A report has been prepared.

Preliminary work has been undertaken in the design of rapid assessment methodology for small woodlots, and field testing began in early 2004. A project web page is under development, and advisory leaflets are being prepared on two key pests and diseases, the cedar shoot borer *Hypsipyla robusta* and the fungus *Phellinus noxius*.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	James Cook University, School of Tropical Biology, Australia
<b>Project Leader</b>	Professor Roger Leakey Phone: 07 4042 1573 Email: roger.leakey@jcu.edu.au
<b>Collaborating Institutions</b>	National Agricultural Research Institute, Papua New Guinea Queensland Department of Primary Industries and Fisheries, Australia Macro Agribusiness Consultants Pty Ltd, Australia Michael Davis Consultants, Australia Commodities Export Marketing Authority, Solomon Islands
<b>Project Budget</b>	\$203,606
<b>Project Duration</b>	01/01/2004 to 31/12/2004
<b>ACIAR Research Program Manager</b>	Dr John Fryer

**Project background and objectives**

A lack of food and income security affects many poor farmers in Papua New Guinea and the Solomon Islands. A variety of indigenous trees produce edible fruits and nuts that could provide increased dietary protein and an additional income source. Elsewhere in the tropics domestication of such trees is providing additional income and enhancing food security. Selection and breeding of such trees in PNG and the Solomons could substantially increase edible produce. The project is identifying the key issues involved in the domestication and commercialisation of trees and their produce, using the *Canarium indicum* tree, known as Galip nut in PNG and Ngali in the Solomons, as a test case. Participatory approaches are being included to establish community attitudes to Galip nut and other fruits and nuts in household diets. The potential to develop markets for these products is being examined in PNG, the Solomon Islands and Australia.

**Project progress**

First progress report is due in early 2005.

## **LWR/2001/050: Equitable groundwater management for the development of atolls and small islands**

<b>Overseas Collaborating Countries</b>	Kiribati, Tonga
<b>Commissioned Organisation</b>	Australian National University, Centre for Resource and Environmental Studies, Australia
<b>Project Leader</b>	Dr Ian White Phone: 02 6125 0660 Phone: 02 6125 3033 Email: ian.white@cres.anu.edu.au
<b>Collaborating Institutions</b>	South Pacific Applied Geosciences Commission, Fiji Tonga Water Board, Tonga Ministry of Works and Energy, Kiribati Ministry of Lands, Survey & Natural Resources, Tonga Ministry of Agriculture and Forestry, Tonga Ecowise Environmental Pty Ltd, Australia Department of Agriculture, Kiribati
<b>Project Budget</b>	\$394,318
<b>Project Duration</b>	01/07/2002 to 30/09/2005 (Project extended from 01/07/2004 to 30/09/2005)
<b>ACIAR Research Program Manager</b>	Dr Ian Willett

### **Project background and objectives**

Groundwater has long been ranked as a high priority research area by small island nations in the Pacific. It is the major source of fresh water (irrigation, agriculture in general and domestic use) in many atolls and small islands and its availability, quality, management and allocation are central to their sustainable development and poverty alleviation. The trade-off between maximising and protecting groundwater resources and maximising overlying crop production presents a dilemma for island communities. This project will study the impacts of cropping on groundwater and of groundwater management on cropping and groundwater resources. The scientists will seek the best ways to manage groundwater equitably in times of drought. They will also determine how to integrate hydrogeological, agronomic, social, economic and cultural information, to assist in setting broadly accepted, long-term goals for groundwater management and allocation and to reduce conflict.

### **Project progress**

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

The project is based in the Republic of Kiribati and the Kingdom of Tonga and involves collaboration between the governments of those countries, the Australian National University, the French agency CIRAD and the South Pacific Applied Geoscience Commission. The project is being run in two phases, techniques are being developed for atolls in the Republic of Kiribati and will be trialed in small islands in the Kingdom of Tonga. The work is divided into 4 subprojects.

#### *Subproject 1. Agriculture and groundwater in atolls and small islands*

This subproject is designed to answer the question: 'What are the impacts of cropping on groundwater and of groundwater management on cropping and groundwater resources?'

Water for human use in Tarawa Atoll, Kiribati, is sourced from domestic groundwater wells, from raintanks and from a pumped groundwater reticulation system in south Tarawa supplied from large, shallow, freshwater lenses in reserves on the islands of Buota and Bonriki. Because soils in coral atolls are mainly coarse coral sands, any surface contamination is carried down rapidly by rainfall or irrigation into groundwater. We have found elevated levels of dissolved nitrogen (up to 19 mg/L) in some groundwaters sourced from areas with some agriculture. Groundwater is also subject to saline intrusion from the surrounding sea.

The principal agricultural enterprises in Tarawa atoll are the cultivation of coconut trees for domestic use and export copra production, the growing of breadfruit and pandanus, the cultivation of vegetables for domestic use and pig and chicken production. The researchers have shown that, once mature, tree crops are able to tap into groundwater and coconut trees can transpire up to 150 L/day. Vegetables are mainly irrigated by hand from domestic wells and pig manure is often used for fertiliser. Because of this areas where water is extracted for reticulation have been declared water reserves and this has caused conflict with land owners.

Population growth in south Tarawa has increased pressure on freshwater supplies and has caused the search for additional sources of fresh water for reticulation. The researchers surveyed and assessed groundwater resources on two islands, Abatao and Tabiteuea, immediately north of Bonriki and Buota and installed 11 monitoring boreholes (5 on Abatao and 6 on Tabiteuea) to measure the thickness of the freshwater lenses and their response to climate extremes. Parts of the freshwater lenses on these islands are sufficiently thick to be sustainable during severe droughts. The maximum thickness of fresh groundwater found on both islands was about 15 m. The thickness varies with island width and other factors including the density of coconut trees. The thickest parts of the freshwater lenses are found on the wider southern ends of both islands. The average thickness over the entire lens was 3.1 m for Abatao and 2.9 m for Tabiteuea. Detailed measurements of the dynamics of groundwater levels at several locations indicate that the hydrogeology of the two islands is similar to Bonriki. The estimated potential sustainable yields of the freshwater lenses are 240 m<sup>3</sup>/day and 230 m<sup>3</sup>/day for Abatao and Tabiteuea, respectively.

Southern Abatao has extensive vegetable crops with ready access to markets. These provide cash income for villages. There is considerable concern that the development of a groundwater extraction scheme on Abatao could impact severely on the availability of water for vegetable production.

#### *Subproject 2. Managing atoll and small island groundwater in times of drought*

This subproject seeks to answer the question: 'What are the best options for managing groundwater equitably in times of drought?'

A simple nonparametric scheme has been developed to assess the severity of drought for different water sources (wells, raintanks, freshwater lenses). This works on monthly rainfall data accumulated over different time periods. The method has been tested for the large freshwater lens at Bonriki. Comparison with measurements of the thickness and salinity distribution in the lens showed that assessment over a running 12 month period provided an adequate representation of the impacts of the drought. Comparison with historic data suggests that a reasonable drought warning system can be developed from the technique with better than 50% accuracy. Measurements of the salinity distribution in the lens following the 1998 to 2000 drought have revealed that major saline intrusion in severe drought occurs at particular locations in the freshwater reserves. Strategies for reduced pumping at these locations as drought evolves have been developed

#### *Subproject 3. Integration of hydrogeological, agronomic, social, economic and cultural information to assist in setting broadly accepted, long-term goals for groundwater management and allocation and in reducing conflict*

This subproject is directed at discovering whether hydrogeological, agronomic, social, economic and cultural information can be integrated to assist in setting broadly accepted, long-term goals for groundwater management and allocation and in reducing conflicts.

In order to facilitate negotiations between sectors of the community with conflicting viewpoints and interest, it was decided to investigate an integrated model that encapsulates social and biophysical interactions. Multi-Agent Based Simulations (MABS) are able to: represent spatially the hydrogeology of atolls; to encompass the daily soil water balance and longer-term groundwater balance and incorporate the behaviour in time and space of water users and water regulators.

A MABS system, Atollscape, has been developed for South Tarawa. This system represents the islands of South Tarawa as 2157 hexagonal land cells. Each cell is isotropic and approximate shape of islands, the connections between them and their lagoon/ocean orientations are broadly represented. The time step corresponds to a 10-day period and the simulations are limited to 10 years.

AtollScape uses a three reservoir (plant interception, soil and groundwater) water balance model, WATBAL, to estimate groundwater recharge. Runoff is ignored because of the large permeability of the coral sand soils. WATBAL uses rainfall and potential evapotranspiration as input data. Recharge of the lens may occur only after plants satisfied their water requirements. Tree crops (mainly coconut trees) extract water directly from the lens. AtollScape takes into account the spatial heterogeneity of the processes and their time dependence. Each freshwater lens collects different recharge values coming from each of the different constituting cells and values are aggregated and averaged over a time step.

The shape and depth of the freshwater lens are estimated using a quasi-steady state, Dupuit-Forcheimer approximation, mass balance from WATBAL and from the estimated abstraction from the lens. The calculations are updated at each time step and adjusted after 12 months. This model is able to simulate the change of the thickness of the freshwater lens with changes in climate and abstraction.

Two classes of social actors have been identified. These are households that use water for domestic purposes and for irrigation and the government water supply agency. The main attributes of each household are: the number of people, the drinking and domestic water requirements, water-consuming equipment and a consumption satisfaction index. New households can be created every time step to simulate the population growth. The government supply agency entity is characterised by the volume of water pumped from the freshwater reserves.

A negotiation support system has been developed based on recently completed surveys of local and expert knowledge of water management issues

#### *Subproject 4. Dissemination of research results*

This subproject addresses the question: 'What are the best strategies for communicating research findings to stakeholders?'

The survey of local knowledge has revealed particular knowledge deficiencies at the village level. In particular there appears to be a general lack of understanding of the impact of surface activities on groundwater quality. The negotiation support system being developed will assist in the communication of this and other important aspects of groundwater management.

## **PHT/2001/023: Horticulture industry development for market-remote communities**

<b>Overseas Collaborating Countries</b>	Samoa
<b>Commissioned Organisation</b>	Queensland Department of Primary Industries and Fisheries, Centre for Tropical Agriculture, Australia
<b>Project Leader</b>	Ms Irene Kernot Phone: 07 40484649 Email: irene.kernot@dpi.qld.gov.au
<b>Collaborating Institutions</b>	Ministry of Agriculture, Forests, Fisheries and Meteorology, Crops Division, Samoa
<b>Project Budget</b>	\$399,559
<b>Project Duration</b>	01/07/2003 to 30/06/2006
<b>ACIAR Research Program Manager</b>	Dr Greg Johnson

### **Project background and objectives**

Horticulture can significantly contribute to community health and nutrition and boost incomes in market-remote regions. However, development initiatives for horticulture often fail to deliver expected benefits, due to choice of unsuitable enterprises or poor extension and back-up technical support. This project is helping to design strategies that harmonise with the way people in such regions access and use information. Project researchers are first identifying, then involving, horticulture industry stakeholders in two remote communities, one in Samoa and the other on Cape York Peninsula, Australia. They are undertaking rapid rural appraisals to assess community models for change, then constructing an information delivery system for key commodity interests, tailored to the participants. The project is helping the targeted communities to routinely assess financial and technical requirements, as well as the market prospects for particular horticultural commodities, to boost success and profitability of their enterprises.

### **Project progress**

First progress report is due in late 2004.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Tonga, Vanuatu
<b>Commissioned Organisation</b>	University of Queensland, The School of Land and Food Sciences, Australia
<b>Project Leader</b>	Dr Jane O'Sullivan Phone: 07 33654811 Email: j.osullivan@mailbox.uq.edu.au
<b>Collaborating Institutions</b>	Ministry of Agriculture and Forestry, Tonga Department of Agriculture Livestock and Horticulture, Vanuatu National Agricultural Research Institute, Papua New Guinea
<b>Project Budget</b>	\$855,308
<b>Project Duration</b>	01/07/1999 to 31/12/2004 (Project extended from 01/07/2003 to 31/12/2004)
<b>ACIAR Research Program Manager</b>	Dr Christian Roth

### Project background and objectives

Yams (predominantly *Dioscorea alata* and *D. esculenta*, but recently also *D. rotundata*) are important staple foods in the Pacific, and hold an esteemed place in cultural heritage. Among the tropical root crops, they are the most demanding of high soil fertility, and this has contributed to the decline in yam production as pressure on land and labour has increased. However, a healthy yam crop can be highly productive and give very high economic returns. This project aims to determine the extent to which South Pacific yam yields are limited by nutritional stresses, and whether yields can be economically increased using appropriate soil fertility management. Local information to help increase quantity and quality of yam crops will be made available to farmers in PNG, Tonga and Vanuatu. An economic study is evaluating the effects of improved nutrient management. A major component of the project is the production of a colour-illustrated field guide on the diagnosis of nutritional disorders in yams—a companion volume to those produced on the other three main root crops, namely cassava, sweet potato and taro.

### Project progress

#### Year 4 (01/07/2002-30/06/2003)

The following activities were achieved in the year to June 2003:

At the University of Queensland, solution culture experiments were conducted inducing deficiencies of iron, boron, manganese and zinc, and toxicities of boron, manganese, zinc and copper. Improvements in nutrient management resulted in much better growth of the yams in solution culture than in previous seasons. Planned experiments on copper and molybdenum deficiencies were not conducted due to failure of sprouting of the planting material.

Some 3000 leaf samples were processed for analysis, including samples from the overseas programs and carry-over from last year. However, temporary decommissioning of the laboratory due to building refurbishment has prevented completion of this season's analyses. A critical concentration for manganese deficiency has been determined at 10 mg/kg in leaves of the 5th and 6th nodes from the tip. Yam germplasm maintenance continued, with the whole collection being planted at Redland Bay Farm for the first time.

In PNG, the project has installed a new 9000 litre plastic water tank and plumbing on the laboratory building at Bubia, to supply high quality rainwater for distillation purposes. This has allowed pot trials to be conducted. A sand culture experiment to induce nutrient deficiency in *D. esculenta* yam has been completed. Symptoms of most deficiencies were successfully induced and photographed. Leaf nutrient levels are awaiting analysis at UQ. On-station active fallow and live-staking demonstration plots with *D. rotundata* and *D. esculenta* completed their first crop of yam. The first season of on-farm

yam trials at Dugumor, Madang Province were harvested in August 2002 and the plots replanted in October 2002. A fertiliser response trial was also planted in October 2002. On-farm trials were established on Kiriwina Island, Milne Bay Province, including four *Gliricidia* live stake plots (to be planted with yam in the 2003-04 season), and two fertilizer response trials in yam gardens. Demonstration plots of active fallow and live-staking with *gliricidia* were further developed at Tanam and Mutzing sites in Markham Valley, but only the Tanam plot could be planted this season, and yams grew poorly apparently due to zinc deficiency. Experiments to address the zinc deficiency are planned for the coming season. The socio-economic surveys in East Sepik, Madang and Milne Bay Province (conducted between May 2000 and February 2002) have been collated and a report drafted.

In Tonga, experiments continued to focus on the phosphorus response of yam, and on the contribution of a *Mucuna cochinchinensis* (velvet bean) cover crop to the nitrogen (N) and phosphorus nutrition of subsequent crops. In Vanuatu, 10 field trials were conducted during the year. Eight evaluated fertilizer responses, based on deficiencies identified through pot trials. One experiment examined effect of *Gliricidia* leaf mulch, and another (still in progress) is comparing planting sets of high and low nutrient status.

The year reported was to be the final year of the project. Research efforts in all programs were expanded, in an effort to make up for delays in the first two years. Good progress was made, with most project objectives achieved by the end of the year. However, some prescribed items remained to be completed, and in other areas an extension would allow promising initiatives to come to fruition. An extension of 18 months was granted to the end of 2004, allowing one additional cropping season and time to collate results.

## **SMCN/2001/038: Management of animal waste to improve the productivity of Pacific farming systems**

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Tonga, Tuvalu
<b>Commissioned Organisation</b>	University of Western Sydney, School of Environment and Agriculture, Australia
<b>Project Leader</b>	Dr Gavin Ramsay Phone: 02 4570 1282 Email: g.ramsay@uws.edu.au
<b>Collaborating Institutions</b>	Secretariat of the Pacific Community, Division of Animal Health and Production, Fiji University of the South Pacific, School of Social and Economic Development, Fiji
<b>Project Budget</b>	\$381,340
<b>Project Duration</b>	01/07/2002 to 30/06/2005
<b>ACIAR Research Program Manager</b>	Dr Christian Roth

### **Project background and objectives**

Evidence from many Pacific island communities suggests that a lot of manure, particularly pig manure, accumulates per unit land area, and that lack of proper management of this accumulation adversely affects the communities. For instance, contamination of potable water underground in atolls or in catchments in high islands leads to diseases in humans such as gastric disorders and even *Leptospirosis*. This project engaged young professionals from the University of the South Pacific to survey several selected villages in each of the four collaborating countries (Fiji, Tonga, Tuvalu, Kiribati), in order to determine current manure management practices and cultural attitudes towards manure. In the light of this information, scientists and the people from the selected communities are working together to identify practical ways of improving management (in particular safe processing and utilisation of manure on gardens and crops but not excluding regulatory solutions). After this, the scientists will field-test agreed improved strategies in a subset of the communities in each country, and disseminate information about successful outcomes.

### **Project progress**

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

Key project activities in the past year include:

Initial project workshop was held in Suva from February 25 to 28, 2003. Outcomes from the workshop included the clear definition of project roles of the national coordinators, research assistants and other project staff as well as development of activities to be carried out to meet the research project objectives. Following the workshop an e-mail discussion list 'Wastenet' was established by the project and hosted by SPC. The list enables communication between members of the research team. In particular the discussion list will help to overcome the communication issues in the project related to both its multidisciplinary nature and being spread over five countries.

Activities in the last year related to specific objectives were as follows.

*Objective 1:* The project has developed links with the LEAD project in FAO and is currently testing and modifying the NuFlux nutrient model for use in Pacific island countries. The NuFlux model will provide information required to develop an appropriate economic model to illustrate the benefits from alternative options for livestock waste management. Initial results from testing of the model suggest that with limited modification it will be useful in the Pacific. Additional data specific to model requirements are now being collected by research assistants and country representatives.

*Objective 2:* Training workshop for research assistants was led by Lionel Gibson in November 2002 to prepare the research assistants for the initial data collection. The research assistants then travelled to their home countries and the first phase of data collection was carried out in three of the four project

countries during the period December 2002 to February 2003. The research assistants then presented their data to the project meeting held from 25 to 28 February in Suva.

*Objective 3:* The identification of culturally acceptable strategies for managing animal waste is building on the findings of the initial work by the research assistants. Important in this has been the perception of the communities in the larger islands that the current situation is acceptable—in contrast to those on the atoll islands who feel a strong need for action. Initial environmental monitoring suggests that on larger islands animal waste is playing a role in reducing water quality. A workshop was held in September 2003 to work with environmental health officers from the various countries as well as research assistants and country project leaders to develop methods of environmental monitoring to assist communities.

# Multilateral

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

<b>Overseas Collaborating Countries</b>	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Cook Islands, Nauru, Tokelau, Tuvalu also collaborate using SPC and NZAID funding)
<b>Commissioned Organisation</b>	International Plant Genetic Resources Institute, Malaysia
<b>Project Leader</b>	Dr V. Ramanatha Rao Phone: +60 3 89423891 Email: v.rao@cgiar.org
<b>Collaborating Institutions</b>	Secretariat of the Pacific Community, Fiji
<b>Project Budget</b>	\$585,000
<b>Project Duration</b>	01/01/2002 to 30/6/2005
<b>ACIAR Research Program Manager</b>	Dr Wendy Morgan

### Project background and objectives

The unique and important diversity maintained in the perennial crop-based production systems of Pacific Island countries is becoming better recognised. However despite efforts to collect, conserve and improve plant genetic resources (PGRs) such as roots and tubers, bananas, coconuts and breadfruit, progress has occurred only with a few crops in a limited number of countries. ACIAR supported a workshop in Lae PNG in 1999 to develop a framework for PGR conservation, management and use in Pacific agriculture. A working group formed at the workshop has drawn up that framework, and funding to progress it has been made available through New Zealand Official Development Assistance. ACIAR is funding a coordinator to supervise the project work and to provide technical advice, and is also augmenting the activities provided with NZODA funding.

### Project progress

#### Year 2 (01/01/2003–31/12/2003)

*Recruit a PGR Adviser for SPC.* Luigi Guarino was jointly recruited as PGR Adviser by SPC and IPGRI and took up the post in June 2002. He has since been liaising with national partners through email, regional meetings and country visits, in particular with regard to carrying out national plant genetic resources stakeholder consultations, to stimulating the exchange of information, and to provide training as necessary. National consultations have been held in five countries. A PAPGREN pamphlet and poster have been published and circulated. A draft list of regional plant genetic resources contacts and a regional directory of genebanks have been prepared in collaboration with partners.

*Support the development of guidelines for intellectual property rights (IPR)-related issues.* A brochure entitled 'Policy Issues Relating to Plant Genetic Resources in the Pacific. A Guide for Researchers and Policymakers' has been published in English and translated into French. Draft Material Transfer Agreements (MTAs) have also been developed by SPC for use by the Regional Germplasm Centre (RGC). Efforts are under way to increase the awareness of countries regarding the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Global Crop Diversity Trust.

*Develop and implement complementary conservation strategies.* A project proposal was developed in 2003 in collaboration with Dr Lois Englberger, a nutritionist with the NGO Island Food Community of Pohnpei, for the conservation of traditional food crops through their promotion for better health and nutrition, with a focus on Micronesia.

A regional consultation on breadfruit conservation in the Pacific was organised in 2002. The consultation resulted in the identification of needs and opportunities and the development of a list of priority activities. The PAPGREN meeting in May 2003 discussed sweet potato yield decline and its significance for genetic resources conservation of this crop. The initial elements of a work plan were agreed. It was felt necessary to investigate yield decline through surveys throughout Melanesia (including PNG highlands and lowlands), to identify stable varieties, and to set up a participatory plant breeding programme based on them. To address this, a project proposal on sweet potato in Melanesia is being developed by the Queensland University of Technology, the University of Queensland and the RGC for ACIAR support.

A major activity in 2003 was the organization of the 3rd Taro Symposium 21-23 May 2003 (<http://www.spc.int/cis/tarosym/Index.htm>). This was held in Nadi, Fiji, with support from IPGRI, CTA, FAO and Japan. Over 60 participants from all the major taro-growing areas of the world participated. The objectives were to review progress in taro research, analyse needs and priorities, develop a strategy for future work in taro research and development, explore new ways to use genetic diversity and improve taro quality and production, and stimulate international collaboration, information exchange and networking. The proceedings are being prepared for publication in 2004. To address the priority issues identified, the RGC is undertaking research on cryopreservation and on seed conservation (in collaboration with Vudal University in PNG), and also entering into an extensive exercise of field testing of virus-indexed taro varieties in partner countries throughout the region.

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

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	WorldFish Centre, New Caledonia
<b>Project Leader</b>	Dr Johann Bell Phone : + 604 641 4623 Email : jbell@cgiar.org
<b>Collaborating Institutions</b>	Australian Institute of Marine Science, Australia Ministry of Agriculture and Fisheries, Solomon Islands
<b>Project Budget</b>	\$785,060
<b>Project Duration</b>	01/04/2000 to 30/06/2005 (Project extended from 01/04/2004 to 30/06/2005)
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

In 1995 ACIAR and the WorldFish Centre commenced a strategic research partnership to develop, assess and transfer the technology for propagating and releasing tropical sea cucumbers. Three separate stages were defined: (1) development of cost-effective methods for producing juveniles; (2) identification of strategies for optimising survival of released juveniles; and (3) evaluation of mass releases of juveniles to existing fisheries. ACIAR funded the first phase, during which work concentrated on sandfish (*Holothuria scabra*), a high-value species of significant commercial importance. The research established that *H. scabra* is suited to restocking and stock enhancement, due to its high value, wide distribution, relative ease of culture and rapid growth at high densities on simple, low-cost diets. Scientists also found that sandfish larvae can be reared *en masse* in hatcheries on micro-algal diets, and the juveniles grown out in simple land-based nursery systems with minimal input of food. This follow-on project is undertaking the second phase of the research, to determine how, when and where to release juveniles for optimum survival, and to identify the most cost-effective stocking densities.

### **Project progress**

#### **Year 3 (01/04/2002–31/03/2003)**

This project was originally located at the WorldFish Coastal Aquaculture Centre in Guadacanal, Solomon Islands. With the destruction of the centre and all its facilities and violence to staff members during the ethnic tensions of 2000, the project was moved to New Caledonia in consultation with ACIAR, and collaborations with local agencies developed. WorldFish recruited new international and local staff co-located at the SPC Headquarters in Noumea. The project continued to focus on the development of technologies for all developing countries of the Pacific region.

The project has encountered three main problems in operating in New Caledonia. First and foremost, the high cost structure has been debilitating and significantly reduced what can be achieved in all areas. The team has taken on additional projects such as breeding black teatfish (*Holothuria nobilis*) and stock assessments of sea cucumber for each of the Provinces in a bid to bring in additional funding. Second, the breeding season for sandfish in New Caledonia is seasonal (approximately October to February) which reduces the capacity of the hatchery to produce juveniles and restricts ecological studies. These contrast with the situation in the Solomon Islands where there is year-round spawning and juveniles could be produced for much of the year. Lastly, the sea cucumber hatchery and production facilities previously available in the Solomon Islands had to be re-established in New Caledonia. This has required additional resources and greater time than was identified in the original proposal. Meeting these challenges has also required a shift in the balance of the project, with more emphasis given to production systems than was the case in the original proposal, which emphasised release strategies.

Since relocation of the project, a small but serviceable hatchery has been established; sandfish juveniles are being produced; research into genetic stock identification is being progressed; new

tagging methods have been developed; and a number of scientific publications have been produced. Other areas of research making good progress include the development of transportation methods, and polyculture of sea cucumbers with shrimp. Preliminary studies into release strategies using enclosures and small numbers of sandfish have provided encouraging results. The challenge is now to undertake larger-scale ecological studies that are more relevant to stock restoration.

Following a review, the project has been extended to capitalise on the investments in facilities and trained personnel. The emphasis of the ongoing work is on the development of practical measures for the production of large numbers of juveniles at reasonable cost, and on release strategies for optimal survival.



# Concluded projects

1 July 2002–30 June 2004

## **Bilateral**

ADP/1998/095: An investigation of the determinants of food choice in Fiji and their role in demand trends for high nutritional valued foods and nutrition security 47

## **Multilateral**

FIS/1998/013: Development of new artisanal fisheries based on the capture and culture of post-larval coral reef fish 49



## **ADP/1998/095: An investigation of the determinants of food choice in Fiji and their role in demand trends for high nutritional valued foods and nutrition security**

<b>Overseas Collaborating Countries</b>	Fiji
<b>Commissioned Organisation</b>	University of Sydney, Department of Agricultural Economics, Australia
<b>Project Leader</b>	Dr Kate Owen 2000-03, Dr Phillip Hone 2003-04.
<b>Collaborating Institutions</b>	Fiji School of Medicine, Fiji Ministry of Agriculture, Sugar and Land Resettlement, Fiji National Food and Nutrition Centre, Fiji Deakin University, Australia
<b>Project Budget</b>	\$312,639
<b>Project Duration</b>	01/07/1999 to 30/06/2004 (Project extended from 01/07/2001 to 30/06/2004)
<b>ACIAR Research Program Manager</b>	Dr Ray Trewin

### **Project background and objectives**

In recent times many Fijians have reduced their consumption of traditional nutrient-dense foods in favour of imported western style foods of low nutrient density. The changes have led to a rise in the incidence of micronutrient deficiencies and conditions such as heart disease and diabetes. Health authorities wish to encourage local people to improve their diets but at present there is little understanding of what influences a consumer's choice of foods. The central objective of this project was to identify the factors influencing consumer choice of foods in Fiji and to recommend where intervention might improve diets, particularly in regard to nutrition-dense traditional food. The research team also developed a model to identify a 'basket' of low-cost nutritious foods to aid in the education of low-income groups,

### **Project outcomes**

The results from the survey of consumption frequency and preferences for staples and proteins confirmed anecdotal evidence that value and convenience are the two key drivers in Fijians' food choices. There has been little change in consumption of staples and proteins for either the Fijian or Indian ethnic groups since 1993. Fijians are consuming slightly less cereals but this can be attributed to the greater than usual consumption of cereals following cyclone Kina in 1993. Urban Fijians consume cassava and bread at higher frequency than other staples while rural Fijians consume cassava, dalo and rice more than others.

There is a significant increase in consumption of dhal among Fijians but protein consumption among Indians has remained unchanged. Among Fijians value for money and ease of preparation are the main factors driving consumption frequency. The concept of 'value for money' is not just about price per item but about feeding the family for a meal(s), and incorporates perceptions of food quality. Personal preferences for taste and texture also play a key role in consumption, and there was an indication that Fijians use spices and other condiments in an attempt to disguise bad flavour or lack of flavour in cheap foods (eg tinned fish).

Among Indians value for money and personal preferences dominate consumption frequency.

Profiles of individual staples and proteins based on key perceptions of product attributes provided insights into the reasons for consumption frequency and can be tested in broader surveys. For example, dalo fares well on most criteria but it is not considered good value for money and it can also be slimy or hard. This profile points primarily to the need to address price issues for higher

consumption, but it may also be necessary to address product quality, perhaps through varietal substitution or education of consumers.

The model for low-cost nutritional baskets has been developed to a stage that it can be used by professional educators and nutritionists, who can further modify it to suit their individual requirements. The model and data are available to a wider audience through the University of the South Pacific's web site.

Results from individual and kitchen diaries provide scope for evaluating nutritional intakes across the sample (including by age, gender and region) and for quantifying nutrient intakes. The diary data has been processed into a form that can be used for further analysis to cast light on issues identified in the national nutrition survey. This data represents the only comprehensive national 3-day food diary database available in the region. It allows modelling of food consumption patterns at the individual household level – something which the national nutrition survey does not facilitate. The data set is now available for public access from the Fiji School of Medicine and the National Food and Nutrition Centre.

Papers have been prepared on the policy implications of the ACIAR project. The general thrust of this part of the research has been on placing nutrition policy within the local agri-food system, focusing on factors driving consumers' food choices and producers' food production decisions. Specifically the analysis has drawn attention to the policy implications of this project for nutrition education, agricultural research and development, and food marketing.

One paper has been directed to the role of health promotion in diet change and the importance of understanding consumer and producer responses to food price changes. It was shown that the design of cost-effective diet change promotion must take explicit account of the potential to change domestic food supply and the consequence of price changes on consumers' diet choices.

The other paper canvasses some of the issues associated with using tax policies and import controls to manipulate food choice. Potential exists for using import duties to target food types that are perceived to have an adverse impact on public health. The social welfare implications of this policy direction are evaluated.

# Multilateral

## **FIS/1998/013: Development of new artisanal fisheries based on the capture and culture of post-larval coral reef fish**

<b>Overseas Collaborating Countries</b>	Papua New Guinea, Solomon Islands
<b>Commissioned Organisation</b>	International Centre for Living Aquatic Resources Management, Coastal Aquaculture Centre, Solomon Islands
<b>Project Leader</b>	Dr Johann Bell Phone : + 604 641 4623 Email : jbell@cgiar.org
<b>Collaborating Institutions</b>	Ministry of Agriculture and Fisheries, Solomon Islands Australian Institute of Marine Science, Australia
<b>Project Budget</b>	\$410,941
<b>Project Duration</b>	01/01/1999 to 31/12/2003
<b>ACIAR Research Program Manager</b>	Mr Barney Smith

### **Project background and objectives**

In the early 1990s an industry was established to collect tropical marine fish for the aquarium trade (mainly for sale in North America and Europe) and harvest groupers, snapper and the napoleon wrasse for sale as live fish for human consumption — often to up-market restaurants in Hong Kong, Taiwan and China. The industry grew rapidly and soon virtually every country in the South Pacific and Southeast Asia supplied one or both of these markets. The high value of the trade led to over-exploitation in several places. In addition, the collection methods often damaged fish stocks. Of particular concern was the use of sodium cyanide to 'stun' fish, which could then easily be collected. In the process, many fish and other organisms were killed.

Non-destructive fishing methods for these species existed, and various NGOs trained coastal communities in their use. However, despite these good intentions, there was growing concern that harvests of coral reef fish were simply not sustainable. A possible solution was to collect postlarval fish in numbers that would not affect the replenishment of natural populations and culture these to marketable size, using simple techniques and readily available food sources. For best results, the fish would be caught whilst still in abundance, which meant before they suffered the naturally high mortality that occurred during their growth.

Fish could be caught either using light traps or crest-nets. Research was needed to determine which method was preferable, as well as to assess levels of abundance and any seasonal fluctuations, and to develop methods for coastal villagers to grow selected species to marketable size. This project concentrated on the situation in Solomon Islands, a country that typified tropical reef fish operations in the South Pacific. Coastal villagers collected about 150 species for exports, although only about 40 species accounted for the majority of sales.

The project aimed to increase the production of marketable coral reef fish and reduce reef damage by providing the means to capture and then rear the postlarvae of desired species in a sustainable fashion.

### **Project outcomes**

The project substantially achieved its research objectives despite a period of civil disturbance that required the evacuation of the on-site project leader, and despite ongoing uncertainty in Solomon Islands. The researchers found that variation in species captured over time was low for most species and generally unpredictable, with the only major exception being the puerulus lobsters, which showed peak abundances in July, August and September during the two years of sampling.

Light traps were found to capture large numbers of low-value fish species and were relatively expensive to construct and operate. Researchers recommended that no further development of this technology for capture of post-larval reef fish in Solomon Islands was justified.

Crest nets, however, captured smaller numbers of high-value species, including lobsters and shrimps. The number of invertebrates and finfish captured in crest nets indicated that further development of this technology could provide an economically viable method for collection of post-larval fish for the aquarium trade. Thus, researchers recommended that further capture technology development should focus on crest nets. In their current form they resulted in substantial mortality of captured fish, so a redesign was advocated.

Neither crest nets nor light traps captured sufficient numbers of fish to supply the live reef fish food trade. The project thus focused on marine aquarium fish. Feedback from the aquarium fish exporter in Honiara indicated that captured-then-cultured fish showed better adaptation to captivity than wild-caught fish, in that they were less 'nervous' in the tanks and more readily accepted food.

A rough cost:benefit estimate indicated that, using catch and value data from the project, a fisher could expect to repay the capital cost of a collection device after about 25 nights fishing. The project team identified a number of potential sites throughout Solomon Islands where modified reef crest collection devices could be established. Reviewers recommended a program of follow-on research, development and extension activities to realise the benefits of the project for coastal communities in the South Pacific.

# Projects under development

at 30 June 2004

## **Bilateral**

ADP/2002/105: Economic and market analysis of the live reef fish food trade in Asia-Pacific

AS2/2003/054: Feeding village poultry in the Solomon Islands

AS2/2004/030: Control of Asian bees - Solomon Islands

ASEM/2003/069: Assessing the impact of agricultural policy changes on the Fiji Islands Agri-Food Sector

ASEM/2004/011: Evaluating domestic tuna fisheries projects

CP/2003/047: Improvement of crop production at village level in the Solomon Islands

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

FIS/2003/070: Market opportunities for seaweed in the Pacific (Fiji, Vanuatu, Tonga, Kiribati)

FST/2002/097: Identification of optimum genetic resources for establishment of local species of sandalwood for plantations and agroforests in Vanuatu and Cape York Peninsular (active at 01/07/2004)

FST/2003/049: Optimisation of the use of mobile sawmills in Pacific island countries

FST/2004/012: Management of weeds, in particular vines, in plantations and natural forests in the Pacific—a scoping study

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

## **Multilateral**

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



# South Pacific consultations

9–10 December 2003

Priorities for collaborative agricultural research between ACIAR and its Pacific Island country partners (Fiji, Samoa, Solomon Islands, Tonga, Vanuatu and Kiribati) were discussed on 9–10 December 2003 in Suva at a consultation with representatives of Regional Organisations (including SPC and University of the South Pacific), relevant Government Ministries and Agencies, NGOs and CGIAR centres active in the region.

ACIAR's strategy in these Pacific island countries addresses the significant challenges of WTO accession, quarantine- and biosecurity-related issues, product quality, scale of production, and remoteness of export markets. We will maintain a mixture of research on cash-generating crops, fishing and forestry with emphases on supply chain issues (including value-adding and marketing) and production sustainability. Projects will emphasise technologies that are appropriate to smallholders, and address institutional issues affecting technology uptake. The limited research capability in the region, especially in individual nations, is an ongoing constraint. ACIAR will therefore work closely with regional organisations, especially the Secretariat of the Pacific Community (SPC), in executing projects. ACIAR also supports collaboration by Pacific Island countries with International Agricultural Research Centres such as the WorldFish Center and the International Plant Genetic Resources Institute.

Agreed priorities are listed under selected ACIAR program areas.

## **Crop Sciences**

- Identification of quarantine and pest risk issues for specific crop germplasm requiring exchange between countries for conservation and introduction purposes
- Development of integrated crop management packages (specifically for pest, weed and disease control and other quarantine issues) for breadfruit, yam and sweet potato
- Integration of existing knowledge into information packages for bananas and taro
- Facilitation of national adoption of earlier research on pest, weed and disease management (including biocontrol)
- In Tonga, research on environmentally-appropriate pest and disease management is required to maintain the export squash industry

## **Fisheries and livestock**

- Stock status assessment and management planning for the sustained use of vulnerable inshore fisheries resources, with an emphasis on increased community-level management and co-management approaches
- Economic and marketing analyses of key aquaculture commodities (initial focus to be seaweed) to better inform producer decision making and to identify opportunities for regional cooperation in marketing and processing
- Regional studies of import risks associated with the movement of live aquatic organisms and the definition of appropriate quarantine measures and strategies
- Investigation of new opportunities for inland aquaculture, including the domestication of promising indigenous species and integration of aquaculture into existing farming systems
- Utilisation of locally-available materials (including waste products) to develop cost-effective feed formulations which improve nutrition in pigs, poultry and aquaculture species

## **Forestry**

- Watershed protection functions and groundwater management in forestry systems
- Domestication of multipurpose trees, including selection of suitable germplasm and silvicultural management
- Sustainable management (and protection from pests and diseases) of high value plantations, including silviculture, harvesting and re-establishment practices

- Value-adding in processing of forest products, including coconut wood and lesser-known species, mahogany branch and salvage wood, and use of mobile sawmills for processing
- Control of exotic, invasive plant species in plantation and agroforestry, especially vine and tree species

#### **Agricultural Economics**

- Land and water resource use planning for optimal development of agriculture, forestry and fisheries enterprises
- Improved agricultural statistics to develop indicators that measure smallholder/ subsistence farmer contributions to national economies. Quantification of the number of farmers producing, levels of household consumption and supply chain linkages.
- Marketing research for root crops, taro and cassava to underpin development of a structured supply chain, with emphasis on quality standards, consistency of supply and packaging requirements
- Economic analysis of current and new farming practices, including of alternatives to slash and burn agriculture and organic farming
- Economic analysis of returns and certification issues of current and potential crops or commodities
- Resource valuations and economic analyses of subsistence and commercial fisheries
- Analysis of the economic tradeoffs incurred in moving from access fee arrangements for Distant Water Fishing Nation vessels to domestic allocation of tuna harvests and onshore processing/transshipment requirements

# ACIAR publications

This list is a selection of titles from ACIAR's range of scientific publications that are relevant to the agricultural research and development sector of the Pacific island countries. Hard copies are available by emailing [comms@aciar.gov.au](mailto:comms@aciar.gov.au). Titles marked with an asterisk may also be downloaded from ACIAR's website, [www.aciar.gov.au](http://www.aciar.gov.au).

## Monographs

- 06 Chemistry of tropical root crops: significance for nutrition and agriculture in the Pacific
- 09 Giant clams in Asia and the Pacific
- 12 Biological control – Pacific prospects: Supplement 1
- 14 The giant clam: an anatomical and histological atlas
- 15 The giant clam: a hatchery manual
- 16 The giant clam: an ocean culture manual
- 18 Giant clams in the sustainable development of the South Pacific
- 20 Biological control – Pacific prospects: Supplement 2
- 27 Recollections of a Pacific entomologist
- 28 The economics of Papua New Guinea tuna fisheries
- 29 Stock assessment of coconut crabs
- 33 Illustrated guide to the identification of banana varieties in the South Pacific
- 35 A survey of the subsistence and artisanal fisheries in rural areas of Viti Levu, Fiji
- 38 Protected area assessment in Vanuatu: a socioeconomic approach
- 40 Essential oils of tropical *Asteromyrtus*, *Callistemon* and *Melaleuca* species
- 44 The major invertebrate pests and weeds of agriculture and plantation forestry in southern and western Pacific
- 45 Report on ACIAR-funded research on viroids and viruses of coconut palm and other tropical monocotyledons 1985–1993\*
- 48 Nutrient disorders of sweet potato
- 54 Survey Toolbox for Livestock Diseases: practical techniques for developing countries\*
- 55 A bibliography of food and other crops in Fiji
- 66 A review of Papua New Guinea's red meat industry
- 76 Plant genetic resources in the Pacific
- 80 Setting policy priorities for the development of tree crop industries in Papua New Guinea
- 81 Policy options for tree crop industries in Papua New Guinea
- 85 Fruits of Oceania
- 94 Survey Toolbox for Aquatic Animal Diseases: A Practical Manual and Software Package\*
- 100 Field methods for rodent studies in Asia and the Indo Pacific\*
- 101 The coconut odyssey: the bounteous possibilities of the tree of life\*
- 102 Lantana: current management status and future prospects\*
- 108 Pig husbandry in New Guinea: a literature review and bibliography\*

## Proceedings

- 20 Management of wild and cultured sea bass/barramundi (*Lares calcarifer*)
- 21 Banana and plantation breeding strategies
- 24 Smallholder agricultural development in Tonga
- 28 Tropical tree seed research
- 30 Tuna baitfish in the Indo-Pacific region
- 47 The biology and mariculture of giant clams
- 52 Tuna baitfish in Fiji and the Solomon Islands
- 53 Coconut improvement in the South Pacific
- 66 Bluetongue diseases in the Asia-Pacific region
- 69 South Pacific indigenous nuts
- 76 Fruit flies in the Pacific
- 78 Mud crabs
- 79 Trochus: status, hatchery practice and nutrition
- 99 Food security for Papua New Guinea\*

## Technical Reports

- 02 Pastures in Vanuatu
- 04 Coconut germplasm in the South Pacific Islands
- 05 South Pacific agriculture — challenges & opportunities for ACIAR & its research partners
- 11 Economic prospects for vanilla in the South Pacific
- 14 Transport of vegetables in Papua New Guinea
- 15 Marketing perspectives on a potential Pacific spice industry
- 18 Post-flask management of tissue-cultured bananas
- 19 Utilisation of remote sensing in the South Pacific
- 23 Allozyme electrophoretic methods for analysing genetic variation in giant clams
- 24 Tuna baitfish and the pole-and-line industry in Kiribati
- 36 A guide to the zygotic embryo culture of coconut palms
- 44 A variety collection of edible nut trees in Solomon Islands
- 46 Kava (*Piper methysticum*) in the South Pacific
- 55 Chromolaena in the Asia–Pacific region\*