

Papua New Guinea and the Pacific

Financial year	Regional expenditure	Percentage of total project expenditure	Commission target as percentage of expenditure
2007-08	8,161,038	19.0%	>20%
2006-07	8,194,666	20.8%	>20%
2005-06	7,467,164	21.2%	>20%

ACIAR’s programs cover five regions. Papua New Guinea and the Pacific islands are grouped as one region. Outlays for the region have been rising in recent years to meet the priorities placed on the region by the Australian aid program. For the region an expenditure target of more than 20 per cent of our overall research expenditure has been set.

PNG 19

Pacific island countries 28



Papua New Guinea

AOP budgeted expenditure in 2007–08	\$4,826,552
Actual expenditure in 2007–08	\$4,964,469
Expenditure in 2006–07	\$5,050,940
Expenditure in 2005–06	\$4,896,886

Dr Jacqui Wright, ACIAR
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Expenditure includes both bilateral and multilateral projects

Key performance indicators	Performance 2007–08
Constraints to expansion of inland aquaculture identified and strategic planning for development commenced	With counterparts, ACIAR initiated national aquaculture priority-setting/coordination meetings. Major constraints to inland aquaculture identified as supply of fingerlings and feed, and training and extension. Inland pond aquaculture project redesigned to better address constraints.
Increased capacity for regional fingerling and feed supply to underpin aquaculture expansion	Improvements in fingerling supply from Eastern Highlands Province hatchery limited but an increase in supply from regional hatcheries (run by private farmers and NGOs) achieved. Research led to major improvements in survival of fingerlings during transport. Four mini-feed mills established at regional centres, and two are already functioning well.
Greater involvement of PNG University of Technology in ACIAR's program	Five Postgraduate Diploma students identified for study at PNG University of Technology in 2008. The students work across ACIAR projects including crop production, evaluation of broiler diets, peanut diseases, farm fish diets and forestry seed production. Since 2005, 19 postgraduates have successfully graduated from this program.
Enhanced focus in project portfolio on improving the quality of commodities	Nine ongoing projects focus on improving the quality of commodities such as timber, sweet potato, coffee, peanut and cocoa.
Maintain linkages between at least two ACIAR projects and projects funded under the new AusAID Agricultural Innovations Grants Scheme	There are strong linkages between at least five ACIAR projects and the projects short-listed under the AusAID Agriculture Innovation Grants Scheme. However, final selection of AIGS projects was pending in June 2008.
Greater involvement of PNG University of Technology in ACIAR's program	PNG University of Technology actively involved in five ACIAR projects in 2007–08, an increase from three projects in 2006–07: cocoa integrated pest and disease management; livestock diseases; and agroforestry value addition.

Key performance indicators	Performance 2007–08
Increased partnerships with other agencies promoting sustainable economic development, in particular the Ok Tedi Development Foundation and the PNG Sustainable Development Program	Ok Tedi Development Foundation current partner in a project on indigenous fish culture and a new partner in the village broiler production project. The PNG Sustainable Development Program is collaborating in implementation of the PNG agroforestry systems project. Several NGO partners are formally involved in ACIAR's program, including World Vision, Lutheran Development Services, Salvation Army Development Program, Rural Women's Development Initiative, People's Action for Community Development, AT projects, HOPE Worldwide and PNG Ecoforestry forum.
Increased emphasis in ACIAR portfolio on sweet potato research and development, commensurate with its importance as a staple food	A cluster of projects addressing production, postharvest quality and marketing of sweet potato have been initiated. These include projects on marketing efficiency, postharvest management and value addition, pest and disease impact on yield, high-carotenoid sweet potatoes, farmer evaluation and multiplication and soil fertility management, with regular communication among project collaborators and joint training activities.
Extent of soil fertility decline of PNG highlands quantified and suitable research and development investments to improve soil fertility implemented	The extent of soil fertility decline and major constraints to production of the most important staple, sweet potato, were identified. The main objective of SMCN/2004/067 is to investigate improved nutrient and water management options for sustainable sweet potato based cropping systems.
Increased emphasis on promoting the role of indigenous nuts in local and export economies	One project addresses processing, handling and storage issues for galip nuts and another addresses regional marketing of the product.
Stronger emphasis on enhancing the contribution of forestry to the national economy, in particular by linking commercial forestry to traditional agroforestry and community management of forests, and by strengthening domestic processing	A project seeks to integrate highly commercial species such as teak and PNG walnut into traditional agroforestry systems, and is making good progress. A second project is addressing the development of a more sophisticated domestic timber processing industry.
At least 40 per cent of new projects designed to have significant farmer or policy-maker impacts within five years of completion	Of 10 new projects that started in 2007–08, six designed to have significant impact on farmers or policymakers within five years of completion.

Position

In 2007–08 the ACIAR–Papua New Guinea (PNG) program continued to support applied technical and economic research aimed at the enhancement of incomes for smallholders. The clustering of research projects around particular issues was further strengthened to improve project integration around priority needs. For example, the project cluster on root crops covered a range of issues from identification of sustainable and profitable production systems to postharvest handling and marketing. Forestry activities focused on linking commercial forestry to traditional agroforestry and strengthening domestic processing to produce high value products. Interlinked projects in fisheries and aquaculture analysed the major constraints to increasing production and various approaches to better address the constraints.

A key component of Australia's support to the agriculture sector in PNG has been AusAID's partnership with ACIAR. This partnership was reviewed in February 2008 and a new partnership covering a period of five years

from mid-2008 was negotiated to secure a more strategic and reciprocal affiliation between the two agencies.

A series of consultation meetings in different sectors (horticulture and food crops, forestry and fisheries) was held in PNG in May 2008 involving PNG participants from government, the private sector, NGOs and the community. Of particular interest was the emphasis across all commodity sectors on cultural, social, and economic constraints to adoption of new, and even existing, technologies.

Achievements

Subprogram 1: Enhancement of smallholder incomes from agriculture

A. Social and economic constraints and opportunities

New work commenced to **raise smallholder productivity and incomes in the oil palm and cocoa sectors** through identifying, refining and promoting effective strategies for commercial sector partnerships with



Prime Minister Mr Kevin Rudd meets with ACIAR Country Office and High Commission staff on his visit to PNG in March 2008

smallholders. Examples of commercial sector engagement are the provision of farm management advice/sale of inputs to smallholders, and joint venture companies between the commercial sector and customary landowner groups that entail various tenancy-type arrangements with conditions of land use. The objectives are to improve extension delivery through greater commercial sector engagement with smallholders, and to develop effective land-use agreements between the commercial sector and customary landowners. A core component is to implement innovative payment systems for productivity-enhancing inputs that accommodate the socio-cultural context of smallholder production.

A Tasmanian pesticide manufacturer has come to the aid of women in the PNG highlands, offering to support the region's **faltering pyrethrum industry**. Botanical Resources Australia approached ACIAR and the Centre agreed to support a project to improve seed lines and seed production through better growing and harvesting. The farmers, mostly women and youth groups, are helped through informal training at their farm sites where they cover topics such as better ways of planting the crop, better management practices and the right time to pick. The skills and technology that the company is introducing have wider applications for other crops such as fresh market vegetables.



Seedling distribution to pyrethrum growing families in PNG



Farmer involvement in sweet potato variety trials

B. Root Crops

The **farmer evaluation and multiplication of sweet potato** project ended in November 2007. During the three-year project, with the assistance of National Agricultural Research Institute (NARI), the project selected 16 different varieties for trial at approximately 142 technician-controlled sites during both wet and dry seasons. After discarding two varieties, the remaining 14 varieties (which included two farmer controls) were tested in approximately 350 farmer-controlled trials, again during both the wet and dry seasons. Data were collected from over 120 trials. The farmers' evaluation of these varieties has been recorded and collated, generating a list of farmer criteria for the adoption of new varieties. In addition, the project also conducted four sequential trials to determine optimum harvesting time for all 16 varieties. Sharing of all findings will take place through a workshop and final technical report. Planting material has now been provided to the wider community, involving 800 farmers, and an estimated 1,400 have subsequently received material from these farmers.

Work has been also undertaken in PNG highlands to identify promising agronomic practices to increase **the productivity of sweet potatoes**, while sustaining soil fertility. The PNG highlands is among the world's



PNG post graduates pass with flying colours at Unitech in Lae, PNG

fastest population growth areas with much intensification of land use. This is placing unprecedented pressure on the land resource and on the long-term productivity of sweet potatoes, the main staple. The project has established an effective network with local institutions and NGOs and on-farm field trials are being conducted in close collaboration with the farmers. The primary target group are smallholder producers in the more accessible and densely populated parts of the highlands that are producing at least some of their crop for small scale commercial marketing, and that therefore have some capacity to invest limited resources into intensifying their production systems. Underpinning this dual strategy is a strong focus on capacity building in soil research and management so that further research and dissemination of soil management techniques can be carried out beyond the life of the project. The inception workshop for new work improving the marketing efficiency, postharvest management and value addition of sweet potato was held in Goroka. Good planning progress was made and partners are enthusiastic regarding the project's potential. A key aspect is the involvement of women's groups from Mt Hagen.

C. Tree Crops

Palm oil is PNG's most important export product, having surpassed coffee several

years ago and having since maintained that position. The main production areas are in West New Britain Province, followed by Oro Province. In both provinces magnesium deficiency is widespread, affecting the oil palm production severely. In many locations direct application of magnesium fertilizers did not show any effect, indicating the need for better understanding of underlying problems related to magnesium deficiency. A project is conducting a series of field investigations and laboratory studies to find a technically efficient and economically viable solution to it. The project is also examining the interactions of magnesium with other plant nutrients such as potassium and nitrogen and a valuable database has been prepared to facilitate the issuing of site-specific fertilizer recommendations to both small holders and estate managers.

Sago is the staple diet in selected areas of PNG (particularly Western Province and East Sepik). But a project has revealed that sago is subject to serious contamination. During the course of the project at least one episode of sago haemolytic disease (SHD), thought to be due to fungi or mycotoxins in the starch, occurred in Western Province. Project members tested a sago sample from the home of the affected family and documented local medical treatments and patient responses. This provided a valuable opportunity to confirm

the possible cause of SHD. The project later identified a potential novel compound from a fungal isolate derived from sago starch that shows strong haemolytic activity with human red blood cells. The project also found that fermentation and storage of sago in palm leaf bundles (in Western province) and clay pots (in East Sepik) posed a relatively low contaminant risk when consumed within a few weeks. By contrast storage in baskets resulted in inferior fermentation and greater risk of contamination from soil or faeces and subsequent chance of food poisoning or SHD.

Subprogram 2: Sustainable management of forestry and fisheries resources

The **purse seine fishery** in PNG is strongly dependent on floating objects as attractants, in particular anchored fish aggregation devices (FADs). Juvenile yellowfin and bigeye tuna tend to aggregate in large quantities around

FADs, and therefore constitute a significant proportion of the catch. Recent regional stock assessments have raised concerns about the long-term viability of these stocks. ACIAR is supporting a Secretariat of the Pacific Community (SPC) regional project which is obtaining information on the dynamics of bigeye, yellowfin and skipjack stocks in PNG waters. The primary method used by the project is to tag-and-release the target tuna species (yellowfin, skipjack and bigeye) in PNG waters. Four periods of vessel charter, involving a commercial pole-and-line vessel, took place. This resulted in 102,400 tunas being tagged and released over a wide area of the PNG Exclusive Economic Zone (EEZ) and neighbouring sections of the Solomon Islands EEZ. As of April 2008 more than 10,000 tags, mostly with good information, had been returned to SPC, representing an overall recovery rate of 10 per cent, in line with expectations of a final return rate of 20 per cent.



Smallholder incomes are enhanced through improved agricultural practices

Locally available animal protein sources for highland communities and subsistence farmers in PNG are limited. ACIAR has initiated a suite of linked projects aimed at the promotion of inland aquaculture based around simple low input pond culture of tilapia and carps to supplement family food budgets and, where circumstances permit, to provide new livelihood opportunities for interested farmers. One project aims to **improve fingerling supply and fish nutrition** for inland aquaculture on smallholder farms, to address what were identified as the major constraints to the sustainability of current farms. Farm-based feeds and husbandry for smallholder fish farmers are also being examined. This is a project with a national focus and, in the last 12 months, smallholder farmers, NGOs and government officers from a range of Lowland Provinces have received training and extended their skills at two project workshops held at the Erap Aquaculture Centre.

Another potential solution is the culture of **suitable freshwater native fish and crustaceans**. Partners Ok Tedi Mining Limited and Western Province have contributed to a project by establishing some ponds for holding broodstock, identifying model farmers, and conducting training. Some native species classified as good potential for aquaculture and restocking have now been supplied to stock the ponds. These include eeltail catfish, sleepy cod, sooty grunter and redclaw crayfish.

Subprogram 3: Biosecurity policy and capacity enhancement

ACIAR has funded six years of project involvement in the **management of taro beetle** pests in PNG and Fiji. Commissioned organisation SPC also used funds from the European Union's project 'Plant Protection in the Pacific' to extend activities to Kiribati, New Caledonia, Solomon Islands and Vanuatu. Research conducted with a fungus, *Metarhizium anisopliae*, led to high beetle mortalities, but damage to the taro corms occurred before the beetles were killed. It was much more effective



Improving fingerling supply and fish nutrition for smallholder farms involved in inland aquaculture in PNG

to judiciously apply suitable insecticides. Using the results of the first four years of work, recommendations on dosages, frequency, methods of application and safety of selected insecticides, imidacloprid and bifenthrin, and other taro growing practices, were demonstrated at Farmer Field Schools in PNG, Fiji, Vanuatu and Solomon Islands. The synergy on low dosages of imidacloprid with *Metarhizium* was also demonstrated. A taro beetle management package resulted. Project results are restoring confidence in taro growing communities of the Pacific and PNG.

A project to learn more about the **red banded mango caterpillar**, a serious pest of mangoes in parts of Asia and now infesting PNG, Torres Strait and the northern tip of Cape York, has gathered information about the biology of the pest, assessed damage levels on fruit and looked for ways to control it. HortResearch NZ had identified a pheromone (which attracted moths into a trap) and this was extensively tested in PNG. After success in PNG the research team set pheromone traps and undertook surveillance to monitor levels of infestation in all five communities of the northern area of Cape York Peninsula. Follow-up testing of the pheromone by the project team and others indicates that pheromone lures have potential as part of an early warning system for detecting the presence of the caterpillar in orchards.

Improving human vitamin A status in Papua New Guinea and Solomon Islands

Many people in Papua New Guinea and Solomon Islands do not receive enough dietary vitamin A, which is vital in boosting immunity to disease. Particularly at risk are infants, children and pregnant/nursing women. Vitamin A supplementation of infants in PNG reduced the effects of malaria, but it would be preferable to receive enough vitamin A through the diet.

Another concern is the large increase in the so-called metabolic or lifestyle diseases such as diabetes, obesity, cardiovascular disease and certain cancers during the past 50 years throughout the Pacific and PNG. This is largely the result of the substituting refined, nutritionally poor products such as white flour, white rice and sugar for traditional highly nutritional diets based on local foods, combined with lack of proper exercise.

The orange sweet potato (OSP) is a nutritionally enhanced staple containing among the highest concentrations of beta-carotene (the major pro-vitamin A carotenoid) of any food – as little as 100 g/day can prevent vitamin A deficiency. An ACIAR-funded project is helping to alleviate the problem of too little vitamin A by assessing coloured Solomon Island and PNG sweet potato cultivars for carotenoids. The project also seeks to understand the cultural and social dimensions of

sweet potato in the diets in Solomon Islands and PNG in an effort to promote OSP as a healthy dietary component and to increase its consumption. Linked to this, the team is introducing improved OSP cultivars (sourced from the International Potato Center) for comparison with the highest-carotenoid local cultivars.

Collection of sweet potatoes is taking place in many parts of Solomon Islands – from Santa Cruz Islands, Makira, Santa Ana, Guadalcanal and Western Solomons/Isabel; World Vision has also sent samples from Madang, PNG. So far, project members have collected and analysed over 50 orange/yellow sweet potato varieties, together with a selection of sweet potato leaf samples and other food crops. They also found that cooking tubers and leaves in coconut cream enhances carotenoid bioavailability.

The project is educating the villagers on the value of including these high nutrition foods in their diets – using workshops, talks and distribution of promotional material. Materials are now being developed in collaboration with World Vision and NARI as part of an effort to bring similar benefits to other areas of Solomon Islands and to Madang Province, where the population has been identified as having the highest risk of vitamin A deficiency in PNG.

The fungus disease **potato late blight** has affected the previously flourishing crops of the PNG highlands. The disease can be combated by an intensive control regime that includes fungicides sprayed every 3–5 days. The best means of dealing with the problem is to identify and distribute blight-resistant varieties, and an ACIAR-supported

project involving the International Potato Centre (CIP) is working to develop affordable varieties, backed up with low-impact reliable fungicides to deal with emergencies. An extension program is also helping to rebuild local confidence in potato cultivation. Approximately 50 different potato clones are being evaluated and tissue culture



Collecting seed in the forests of PNG

methods employed to multiply the material for further testing and to fast-track vegetative multiplication so the resistant varieties can be distributed quickly.

Increasing the productivity of livestock depends largely on addressing a range of constraints, including those caused by diseases such as **leptospirosis and trichinellosis**, two zoonotic diseases (capable of transmission from animal to human). In PNG excellent capacity-building has taken place among technical and professional staff, and there has been strong engagement with commercial cattle producers. Encouraging progress includes development of antibody detection tests for *Trichinella* and *Leptospira* and establishment of serological diagnostic capability for these organisms at the National Veterinary Laboratory. There is now improved epidemiological knowledge about leptospirosis

infection in cattle in PNG, and confirmation *T. papuae* is more widely distributed in PNG than previously thought. The project has made use of an extensive SPC serum bank and has generated much valuable baseline information for further activities.



Agronomic practices increase the productivity of sweet potatoes

Pacific island countries

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

Dr Jacqui Wright, ACIAR Country Manager, PNG and Solomon Islands



Expenditure includes both bilateral and multilateral projects

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

Key performance indicators	Performance 2007–08
Field testing of promising sustainable management practices and value addition demonstrated in forestry and agroforestry projects	Projects aimed at testing and implementing sustainable agroforestry systems with high value species are under way with whitewood in Vanuatu, and another with teak and rosewood in Solomon Islands. Another project aimed at developing coconut wood for the Australian flooring market is making good progress.
At least 40 per cent of new projects designed to have significant farmer or policy-maker impacts within five years of completion	Four of the five new projects commenced in the Pacific in 2007–08 were designed to have significant farmer or policy-maker impacts within five years of completion.

Position

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

Participation in regional projects that address common problems has assisted with helping to overcome the limited capacity of many countries to engage in collaborative activities. ACIAR's 2007–08 program has had a strong emphasis on working with Pacific Regional

Organisations to improve effective delivery of outputs.

In 2007–08 the ACIAR program has taken a holistic approach, linking agriculture, forestry, fisheries and environment more closely. ACIAR has had the opportunity

through a number of projects to explore new niche agricultural, fisheries and forestry products to achieve diversification and income growth as well as facilitating domestic and export market access through a focus on biosecurity issues and improved quarantine resources.

Achievements

Subprogram 1: Improving incomes through productive farming systems

Sustainable aquaculture development is imperative in the Pacific islands region. A series of 14 miniprojects has focused on **eight aquaculture commodities in nine Pacific island countries**. Examples of outcomes include determination of the viral disease status of *Penaeus monodon* shrimp stocks in Fiji, paving the way for the development of improved quarantine and testing procedures, and demonstration that the native freshwater prawn *Macrobrachium lar* can be successfully cultured in ponds as an alternative to the introduced *M. rosenbergii*. Other projects demonstrated improvements in husbandry for artisanal fish farmers in PNG and Fiji through formulation of cheap, locally available fish feeds. In Solomon Islands the research team developed improved sponge culture methods and investigated markets for Pacific bath sponges. Building on this work, an EU-funded project is supporting village-based farming operations with the aim of producing sufficient





ACIAR funds a range of fisheries management projects in the Pacific

quantities of sponges to allow a realistic assessment of the market potential in New Zealand to be evaluated. Through mini projects, local farmers and aquaculture officers in a number of countries have now been trained to collect and/or breed and culture species such as Nile tilapia, indigenous freshwater prawns, anguillid eels and sponges. Fisheries officers also increased their skills in a wide range of areas including feed formulation, feed management, mabe (half pearls) pearl production, survey techniques, water quality monitoring and data recording.

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

Also in Tonga the **winged pearl oyster, *Pteria penguin***, is traditionally used for production of mabe pearls for export market to Japan and elsewhere. This oyster species was introduced to Tonga in 1975 and at the end of 2000 there were 25 small pearl farms. A major impediment to the sustainability and expansion of the pearl industry in Tonga is a reliable and adequate supply of oysters. Over recent years, poor recruitment of spat has resulted in the harvesting of adult oysters from the wild, which has further impacted recruitment, and natural spat fall of *Pteria penguin* in Vava'u is now extremely limited. A project is focusing on the development of appropriate hatchery culture techniques for *Pteria penguin* and the use of hatchery-propagated oysters for pearl production. The research will help to optimise culture methodology and pearl production as a basis for sustainable industry development.



Kiribati locals take part in ACIAR-sponsored jewellery making workshop using local pearls

Globally, **horticulture, including floriculture**, has become a lead sector for poverty reduction in developing countries. This, however, has not been the case for the Pacific islands. A scoping study investigated the potential for developing the ornamentals industry in the Pacific. While the study specifically covered Fiji and PNG, much of the findings were seen as relevant for the region as a whole. The study found that Fiji's comparative advantage in ornamental horticulture lies in supplying the non-tourist domestic market, and the



Ornamental horticulture and cut flowers offer niche export opportunities in the Pacific

industry had made good progress in realising this opportunity. It has been less successful with respect to the tourism segment which offers the most growth potential. Niche export opportunities have been identified for specialty leaves and for indigenous orchids. By contrast PNG offered some outstanding agro-ecological conditions for cut flowers and foliage, but in terms of export market development these advantages were more than offset by intractable marketing and other constraints. It is highly unlikely that PNG could establish a cut flower export industry comparable to that of East Africa and Central America, but a worthwhile cut flower industry could be built around a significant expansion of the domestic market, supplemented by niche export of specialty products.

Evidence from many Pacific island communities suggests that much **animal manure accumulates** per unit land area, and that lack of proper management of this

accumulation can contaminate potable water underground in atolls or in catchments in high islands. Scientists and the people from selected communities are working together to identify practical ways of improving management. A project involving Fiji, Tonga, Tuvalu and Kiribati is leading to improvements for communities in all four countries. In a Tongan village 10 farmers have changed from a free-range extensive system, where pigs roam free in the village and nearby land, to a semi-intensive production system with pigs housed at all times. Farmers, at their own instigation and in association with Ministry of Agriculture staff, are already developing ways to improve the way they feed their confined pigs and developing improved health programs. In Tuvalu there is potential for a positive impact on the environment as farmers change the design of their piggeries as well as their waste management. In both Fiji and Kiribati farmers have begun to use

animal waste as compost in vegetable gardens. There are potential economic gains in all communities through substitution of organic manure for expensive fertilisers, and farmers have also noticed improved soil structure.

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

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

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

Subprogram 2: Sustainable management of forestry and fishery resources

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



Coconut wood flooring

communication between industry, research and other stakeholders. A network comprising industry contacts in Australia, Fiji and Samoa, including flooring market and production specialists, potential resource suppliers and processors, is now in place.

A good start has been made on two projects that are designed to **underpin good silvicultural practice** in the emerging high value plantation timber industries of Vanuatu and the Solomon Islands. The species involved are whitewood (*Endospermum medulosum*) in Vanuatu and teak (*Tectona grandis*) in particular in Solomon Islands. In both cases, the objective is to develop silvicultural protocols that are compatible with local agroforestry practices. This will involve interplanting with a fast-growing pole species, *Flueggea flexuosa*, in the Solomon Islands, and intercropping with agricultural and horticultural species in Vanuatu.

The particular challenge for another project has been to assist remote rural communities to develop and adopt **sustainable resource use practices for sea cucumber** (harvested for commercial purposes) in an environment where there is often poor understanding of the relationship between fishing pressure and future harvests, where processes for negotiating shared management responsibilities are not well developed, and where there are few alternative sources

of income to meet their few, but important, monetary needs. The Government-imposed moratorium on the harvest or export of beche-de-mer (processed sea cucumber) from December 2005 to May 2007 provided the project team with the opportunity to work closely and at length with one community, Kia, in Isabel Province, to provide training and workshops, and to assist the community to draft its management plan for the sea cucumber fishery. The process of 'hastening slowly' has led to impacts well beyond the target community with the Kia community resource management plan leading to development in 14 other coastal communities, along 140 km of coastline. The Kia marine resources management plan has been officially implemented and project-trained villagers are carrying out the monitoring that will feed back into the management practices, using principles of adaptive management. A similar approach was adopted in a village cluster on the west coast of Vella Lavella, in the Western Province. The next steps will focus on scaling out this work to coastal communities throughout Solomon Islands in a follow-on ACIAR-funded project, with the Ministry of Fisheries and Marine Resources and FSPI (a regional non-government community-focused organisation) as partners.

Subprogram 3: Biosecurity and pest and disease management

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



Les Baxter (ACIAR) examines work on the ginger project with plant pathologists in Fiji

positively identified. One of these was of quarantine significance – the Asian ambrosia beetle (*Xylosandrus crassiusculus*).

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

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

Both large and smallholder farmers in the Pacific islands grow brassicas, mainly head cabbage, Chinese cabbage and watercress,

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

Subprogram 4: Farming systems economics and marketing

A project has attempted to empirically assess the economic and environmental impacts of agricultural trade liberalisation on the Fijian economy, as well as the environmental

The good oil on sandalwood

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

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

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

The project established a ‘host’ trial in Port Vila (sandalwood is a root parasite and must have a host of another species). Species under trial are *Canarium indicum*,

Casuarina equisetifolia and *Pterocarpus indicus*. Ni-Vanuatu project participants received instruction in sandalwood plantings establishment, nursery establishment and procedures, sandalwood propagation, plantation establishment and plant improvement.

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

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

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

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



Sandalwood growers in Vanuatu

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

Nurturing horticulture opportunities was the driver for a unique collaborative venture between the Queensland Department of Primary Industry and Fisheries and the Samoan Ministry of Agriculture and Fisheries. The project is benefiting both indigenous communities in Cape York Peninsula and in

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