ACIAR COUNTRY PROFILES 2008–09: PAPUA NEW GUINEA

ACIAR

Research that works for developing countries and Australia

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1 Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of 38 projects that are active in 2008-09. There are another 9 projects under development, which are expected to start in 2008–09 financial year.

This publication also sets out the key outputs and outcomes from 8 projects that have been completed in 2007-08.

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

ACIAR updates this profile each year and distributes it to key stakeholders in Papua New Guinea and Australia.

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

Peter Core

Chief Executive Officer

November 2008

2 Overview

2.1 About ACIAR

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

ACIAR aims to enhance rural household incomes and broader economic growth by investing in international research partnerships that encourage agricultural development, sustainable use of natural resources and capacity-building.

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

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

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

Our partnership model

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

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

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

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

Where we work

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

- South-East Asia (Cambodia, East Timor, Indonesia, Laos, Philippines, Thailand, Vietnam: >45% bilateral expenditure)
- Papua New Guinea and the Pacific islands (>20% of bilateral expenditure).
- North Asia (China: <15% of bilateral expenditure)
- South Asia (Afghanistan, Bangladesh, Bhutan, India, Iraq, Pakistan: <15% of bilateral expenditure)

Working internationally

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

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

2.2 ACIAR's program in Papua New Guinea

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

ACIAR's program with Papua New Guinea as at 30 June 2008.

Bilateral program

Active projects	36 with a value over their lifetime of approximately $23.045 million
Projects under development	13
Completed projects	95

Multilateral program

Active projects	5 with a value over their lifetime of approximately $3.791 million
Projects under development	0
Completed projects	6

Total project budget 2008–09	$5.42 million which represents 13.3% of the total project budget 2008–09

The research program in Papua New Guinea is looking at the following agricultural priorities:

- Enhancement of smallholder incomes from horticulture and root crops
- Improving smallholder returns from export tree crop production and marketing
- New livelihoods from smallholder fisheries, aquaculture and forestry
- Sustainable management of forestry and fishing resources
- Agricultural biosecurity
- Addressing social, cultural and policy constraints to the adoption of agricultural technologies
- Institutional and individual capacity building.

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

Papua New Guinea Subprograms

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

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

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

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

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

2.3 Capacity building and training

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

The ACIAR training program has a budget in 2008–09 of approximately $5.38 million. It comprises five elements:

- Fellowships for postgraduate students (John Allwright Fellowships)
- Postgraduate returnee follow-up awards (Returnee Small Project Awards Scheme)
- Leadership development opportunities for developing country scientists (John Dillon Memorial Fellowships)
- Non-award training (short courses and workshops), including support for the Crawford Fund
- On-the-job training.

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

John Allwright Fellowship

The objective of the John Allwright Fellowships is to increase the research and development capacity of ACIAR partner country institutions. The fellowships are awarded to partner-country researchers involved in an ACIAR project to undertake postgraduate studies in tertiary institutions in Australia. Studies focus on areas related to the topic or theme of the ACIAR project.

John Allwright Fellowships in Papua New Guinea

		PhD	MSc/Other
Active	Male	8	8
	Female	4	3
Concluded	Male	3	10
	Female	0	5

Returnee Small Project Awards Scheme

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

John Dillon Memorial Fellowship

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

Short courses and workshops

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

On-the-job training

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

2.4 Policy Advisory Council member

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

The current member from Papua New Guinea Mr Brown Bai, Chairman, Rural Industries Council. Mr Bai has been a member of the Council since March 2005.

3 Papua New Guinea chapter from the Annual Operational Plan 2008–09

GDP per capita (PPP[a] US$)[b]	2,563
Population (millions)[b]	6
Projected population (millions) 2015[b]	7
Active bilateral projects[c]	34
Active multilateral projects[d]	5

Bilateral actual 2006–07	$4.8 m
Bilateral estimate 2007–08	$4.5 m
Bilateral budget 2008–09	$5.0 m
Bilateral + multilateral budget 2008–09	$4.9 m

[a]Purchasing power parity (see Appendix 4: Selected world development indicators)
[b]Source and also for following chapters: United Nations Development Programme, Human Development Report 2007–08, <*http://hdr.undp.org/en/media/hdr_20072008_en-complete.pdf*>
[c]For all country chapters this figure indicates active bilateral projects as at July 2007
[d]For all country chapters this figure indicates active multilateral projects as at July 2007

3.1 Medium-term strategy

The ACIAR program aims through applied technical, social, economic and policy research to achieve practical impacts for PNG smallholders, consumers, industry and government. To achieve these goals, ACIAR facilitates and supports research and development activities for efficient use of sustainable resources for more productive and sustainable agricultural systems. Emphasis is placed on the social and economic context of the research, particularly with respect to involvement of women farmers. There are emphases on plantation crops, root and other horticultural crops, forestry and fisheries. These include exported and domestically traded commodities that generate smallholder income and underpin improved food security and economic development. PNG has several significant competitive advantages in relation to the production of timber. The opportunity exists to develop a timber growing and processing industry many times larger than the current log export industry from primary forests.

The ACIAR program includes tightly linked clusters of projects addressing problems faced by major commodities such as sweet potato, coffee, oil palm and cocoa. Program design also encourages private sector, industry and NGO linkages in design and delivery of activities. Through addressing issues of biosecurity and sustainable management of land, forest and fisheries resources, sustainability of renewable resources is encouraged. The program has a strong emphasis on capacity building, with high priority given to both training within projects and postgraduate training. In addition to the project expenditures shown above, between $ 1-1.5 m is invested by ACIAR annually on training in PNG.

AusAID and ACIAR work closely together in Papua New Guinea. AusAID co-invests into ACIAR-managed project activities, while ACIAR works closely with relevant AusAID programs, particularly the Agricultural Research and Development Support Facility.

3.2 Key performance indicators (2008–09)

- social, cultural and technical constraints to increasing smallholder productivity and income in the oil palm and cocoa sectors identified, and promising technologies disseminated
- introduction of high-value species to smallholders in for efficient and sustainable production of timber in forestry and agroforestry systems in at least one province
- development and dissemination of improved feeding strategies and completion of training programs to increase farmer skills in pond husbandry in village-based aquaculture at least two districts
- initial strategies developed to reduce threat of coffee berry borer and impact of cocoa pod borer on smallholder farmers
- technologies developed to increase sweet potato crop yield through appropriate management of soil and nutrients

- direct linkages between at least three AusAID-funded ARDSF projects and ACIAR research outputs
- 40% of new projects designed to have significant farmer or policymaker impacts within 5 years of completion

3.3 Position

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

Village-based agriculture supports over 70% of the population, and domestic trading of fresh produce is a very important source of cash income. By far the most important crop in PNG is sweet potato, the dominant staple for over 65% of the rural population. The main export tree commodities are timber, oil palm, coffee, cocoa and coconuts. Forestry is PNG's third largest revenue earner and a major contributor to economic and social development. PNG has several significant competitive advantages in relation to the production of timber—available land, good soils and climate, and a long history of successful incorporation of trees into agroforestry systems. The PNG fisheries zone of 2.4 million square kilometres is the largest in the South Pacific. The fisheries zone includes an extended reef system, numerous islands and an extensive coastline. These create huge opportunity but also present an enormous challenge for monitoring and control. The total market value of the PNG catch is estimated at $A140–160 million. Pigs and poultry are important village animals and there are some live exports of cattle from PNG. ACIAR will assist in the development of capacity to detect and manage infectious disease in the wider context of biosecurity arrangements and in collaboration with other Australian agencies. Where relevant, close linkages will be formed between ACIARfunded programs in PNG and the Pacific Islands, for example in root and tree crops, fisheries and forestry.

Key principles in designing and executing the program include the importance of engagement with the private sector, industry bodies and NGOs along with government in both research and implementation of research results; the importance of research that assists the engagement of smallholders in the cash economy; and the importance of understanding social and economic issues affecting farmer decision making and factors influencing adoption of new technologies. Research is urgently needed into more effective ways of up-scaling the adoption of R&D results from pilot level involvement of communities to enable broader implementation. ACIAR will work with counterparts to assist in communication and extension of the results of research. As well as making a greater commitment to the implementation of the results of research, the need for on-going development of agricultural technologies remains strong.

There is particular need to develop the informal sector (including those involved in village level production and marketing of root and horticultural crops, small livestock), improve the productivity of major tree crops (increase production and exports, lower production costs), and to support research and development that assists in diversification of the agricultural export product base.

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

3.4 Relationship to the AusAID PNG strategy

AusAID's PNG program supports the Government of Papua New Guinea's medium-term development strategy focus on sustainable broad-based economic growth for the country. It does this by working with PNG government agencies and systems to ensure better use of the country's own resources, leading to stronger economic management, better delivery of essential services, and improved law and order. The importance of strengthening political governance, building sustainable government institutions, exploiting opportunities to stimulate sustainable economic growth and maintaining service delivery is recognised. In 2008–09 the program focus will be on improved governance and nation building, sustainable broad-based economic growth and increased productivity (including from the agriculture, forestry and fisheries sectors), improved service delivery and stability, and responding to the HIV/AIDS crisis.

ACIAR's PNG program, delivered with AusAID cofunding, supports the emphasis on economic growth by working with PNG government agencies to improve agricultural productivity. Partnership with PNG public and private institutions supports better use of PNG's own resources. With more than 85% of the population in rural areas, development of agricultural industries and the smallholder cash economy will be critical to achieving broad-based economic growth and improving rural livelihoods in PNG.

3.5 Research priorities

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

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

- Interventions to overcome cross-cutting social and cultural constraints to smallholder household profitability/ productivity based on analysis of:
  - Land mobilisation issues (tenure, registration, titles, communal)
  - Applicability of new labour mobilisation models beyond the cocoa and oil palm industries
  - Impact of smallholder involvement in participatory action research activities and other adult / group learning processes on adoption of technical innovations
  - Effects of cultural factors on ability to replicate successful entrepreneurship in agriculture
  - Analysis of income utilisation, savings incentives and microfinance access in smallholder families, particularly with respect to establishing criteria for successful engagement of women
- Analysis of how current production and marketing systems impact on women (labour, timing, marketing) in terms of efficiency and equity, and the role and effectiveness of womens' groups in agriculture and rural industries
- Role of cottage industries in contribution to livelihoods, household cash flow and complementing engagement in formal markets and the national economy
- Economic assessment of rice trade and rice-based farming systems, including national demand (role of production and imports) and potential returns from investing in technical improvements

- Improved crop water management under climate variability and change including
  - management of water availability (including through low-cost irrigation) to meet market demand and food security
  - identification of drought-vulnerable areas for PNG and potential policy and technical interventions

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

- Matching supply to demand and marketing of highland root and horticultural crops:
  - Understanding the sector to clarify demand of different product categories (fresh, processed, selected export) in major markets
  - Understanding relative effectiveness of different collaborative arrangements for mobilising smallholders (e.g. 'clustering' farmers versus using co-operatives) from social and cultural perspectives
  - Economics of storage depots, role of private sector versus government intervention
  - Establishment of criteria for productive relationships between smallholders, middlemen and private sector buyers and sellers
- Application of traditional staple crop varieties (sweet potato, taro and banana) and identification of suitable potato and other root crop varieties for village-level and commercially-processed products
- Identification of quarantine barriers for potential export of root crops and flowers to other countries
- Use of legumes and fallow crops for soil fertility improvement and longer term nutrient supply in vegetable production systems
- Analysis and interventions in market chains for key temperate vegetables, including collation of market information and strategies to improve post-harvest operations
- Assessment of simple technologies and mechanisation systems for family and community production, postharvest handling and storage of horticultural crops
- Improvement of seed multiplication, distribution and marketing systems, including assessment of strategies for enhancing availability of quality seed
- Improved productivity and profitability of sweet potato based farming systems, including:
  - development of breeding and selection strategies for important traits in sweet potato for different regions (lowlands, highlands, higher altitude) including yield, stress tolerance (salinity, excess moisture, drought tolerance) and consumer preferences (colour, taste, texture)
  - development of integrated pest, disease, weed and nutrient management strategies
  - evaluation of industrial opportunities for processed sweet potato products
- Identification of promising root crop - legume - tree - livestock systems that provide better use of crop residues for nutrient cycling and local sources of animal feed

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

- Social and economic analysis of incentives for uptake of intensified management systems (fertilizer, pests, disease and plantation management) in cocoa, coffee and oil palm (including reinvestment of income)
- Development and application of GIS database for coffee, cocoa and oil palm with a focus on management of pest and disease outbreaks
- Impact of cocoa pod borer infestation and of potential coffee berry borer infestation with respect to socioeconomic impacts on smallholders and implementation of pre-border, post border spread, incursion management, and surveillance
- Development and smallholder implementation of biocontrol systems for major oil palm pests (sexava, eurycantha) and diseases (ganoderma)
- Assessment of natural resource sustainability indicators for tree crop industries

- Management systems for processing wastes for coffee and other tree crops to underpin development of environmentally sustainable production practices required for certain export markets

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

- GIS based tools that integrate aquaculture into existing land use systems and socio-economic contexts
- Small-scale inland aquaculture, including cost-effective feeds and feeding strategies, and increased availability of quality fingerlings
- Evaluation of livelihood opportunities in recreational fishing resources such as black bass
- Development of agroforestry systems, addressing
  - Integration of high value tree crops into agricultural systems, particularly involving rubber in the Western Province and in contour terraces in the highlands
  - Germplasm development, delivery and conduct of agroforestry demonstration sites
  - Social, cultural and economic motivation for landowners planting trees
- Social and economic approaches to improve PNG smallholder involvement in forestry and agroforestry, addressing socio-economic mapping, land tenure and user rights issues, participatory processes to foster community engagement
- Improving economic returns from timber processing, including analysis of economic analysis of sawmilling strategies, improving sawn log recovery and utilisation of small diameter logs from secondary forests

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

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

4 Active projects in Papua New Guinea

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

Projects

ASEM/2004/011: Evaluating domestic tuna fisheries projects

Summary

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

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

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

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

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

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

Project Leader

Professor Harry Campbell
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Collaborating Institutions

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

Project Budget: $331,435

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

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

Year 2 (01/06/2007-31/05/2008)

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

ASEM/2004/077: Postgraduate Scholarship Scheme for UNITECH, University of Lae, Papua New Guinea

Summary

In response to new initiatives by University of Technology (Unitech), Lae, PNG, to introduce a program of post-graduate training in 2005, ACIAR is funding a scholarship program to support students during their training. It is proposed to provide funding initially in 2005 for 6 students (stipend plus all costs associated with project administration and research support). It is anticipated that this program will run for three years, training in total 9 candidates to PG Diploma level and 6 as MPhil graduates. Unitech staff will supervise these projects with planning assistance from senior UQ staff, and will be encouraged to seek research linkages with existing ACIAR, NARI and industry projects. Progress will be reviewed each year, and continuation recommended where each year group of students graduates in the prescribed time.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Queensland, School of Land and Food, Australia

Project Leader

Dr Barry W Norton
Phone: 07 3289 0260
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Collaborating Institutions

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

Project Budget: $741,049

Project Duration: 01/01/2005 to 31/12/2008 (Project extended from 01/07/2008 to 31/12/2008)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

The ACIAR Scholarship Scheme was initiated in the Department of Agriculture at Unitech at the beginning of the first semester in March 2005, when 6 scholarships were awarded, one for MPhil studies (two years) and 5 for Post-Graduate Diploma (PGD) studies (one year). In March 2006, 3 students graduated with PGD, with three scholars continuing with MPhil studies (two PGD scholars had been upgraded to MPhil). At this time, a further 7 scholarships were awarded for PGD studies. In April 2007, all 2006 PGD and three MPhil students graduated, bringing the total graduated under the scholarship scheme to 13 from 13 appointments. In 2007, a further 5 scholarships were granted (3 in Agriculture, 1 in Forestry and 1 in Applied Science). All candidates successfully graduated in March 2008, bring the total number of ACIAR graduates so far to 18 (15 PGDiplomas and 3 MPhil). Project theses are available from Unitech on request. Topics in the last year have included studies of the incidence of peanut yellow stripe virus in PNG, use of indigenous leguminous trees in PNG Forestry, flotation characteristics of locally made fish feeds, use of local ingredients for chicken rations and effects of soil compaction on plant growth. A further 6 scholars have been appointed for PG Diploma Studies in 2008, with 4 from the Department of Agriculture, one from Forestry and one from Applied Science

In this year, new equipment (Inductively Coupled Plasma Atomic Emission Spectrometer (ICP) and LECO C:N analyser) was installed and made operational in a newly equipped laboratory at Unitech. Mr Tata Telawiki, Unitech Laboratory Manager, is drawing up a business plan for the Unitech and commercial use of this equipment, and will be undertaking further training under Mr Graham Kerven, Senior UQ Laboratory Technologist, at UQ later this year. Four Unitech staff, partly supported by project funding, visited the University of Melbourne seeking collaboration for their interests in farming systems research at Unitech. Later in the year, a workshop will be held among the students, staff, government and industry employers and ACIAR to determine how effective the outcomes have been from this project and to outline possible new directions for the project in future.

ASEM/2005/094: Improving the profitability of village broiler production in PNG

Summary

NARI has identified the improvement of profitability for village broiler farming through the use of locally available feedstuffs as an issue of highest priority for the PNG livestock sector. This sector produces about 6.7 million birds per year valued at $A50 million, using high genetic potential birds and commercial feeds.

Lowland provinces close to the feed mills account for 60% of production, with the balance of 40% from highland provinces. But future viability in both regions is threatened by rising costs of imported ingredients for the commercial feeds. This problem has been made much worse by the massive reduction in the value of the Kina and consequent increases in cost of all imports. As most feed ingredients are imported this has led to the approximate doubling of costs of broiler production.

Food crops and agro-industrial by-products (such as copra meal, fishmeal and palm kernel meal), locally available in PNG, have been found suitable for use in broiler rations. However, the high cost of transport, together with storage difficulties and constraints in feed formulation, make it difficult for the feed mills to use these feed resources in complete rations. But ACIAR project LPS/2001/077 has developed an alternative strategy whereby PNG fishmeal and copra meal (plus minerals and vitamins) can be incorporated into a concentrate that can be supplemented with 50-80% of local ingredients (e.g. sweet potato) to make up the whole ration.

This project aims to expand and test a range of concentrates plus local feeds on-station and on-farm, and to consider two strategies to produce concentrate feeds. Major objectives are to develop on-station a range of best-bet feeding options for broiler production and profitability, to evaluate broiler production and profitability on-farm of various feeding options that incorporate local feeds, and to promote the widespread adoption of alternative feeding options for broilers that will improve profitability.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $399,950

Project Duration: 01/01/2007 to 31/12/2009

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

Improving the profitability of village broiler farming through the use of locally available feedstuffs is a high priority in the PNG livestock sector. Lowland provinces close to the feed mills account for 60% of broiler production with 40% in highland provinces. The village broiler Industry is valued at $67m. The viability of village broiler farms in both geographical regions is threatened by the rising costs of imported ingredients used in commercial feeds.

An earlier project developed a strategy whereby PNG protein meals (plus minerals and vitamins) were used to produce a concentrate that could be fed to broilers with 50-80% of local ingredients. The feeding method resulted in good bird growth. The new project is using two sources to manufacture the concentrate feeds. The concentrate will be made by a commercial feed mill and also by regional poultry and fish feed manufacturing and distribution centres. A strong focus in the project is placed on

delivery of feeding strategies to village farmers through the participation of Non Government Organisations (NGO's). Christian Leader Training College (CLTC) in the highlands and Lutheran Development Service (LDS) in the lowlands were provided funding to renovate existing poultry facilities to make them suitable for conducting regional specific broiler feeding demonstrations for village farmers. The NGO's will disseminate the feeding strategies more widely later in the project by supervising village farm trials.

The project commenced by evaluating the Apparent Metabolisable Energy (AME) of low energy (AME 2300 Kcal/kg, Crude Protein (CP) 40%), medium energy (AME 2500 Kcal/kg, CP 43.5%) and high energy (AME 2800, Kcal/kg, CP 41%) broiler concentrate diets at the National Agriculture Research Institutes (NARI) broiler feed evaluation unit in Lae. The data indicated that the best options were to feed broilers a low energy concentrate with added sweet potato and to feed cassava with a high energy concentrate. Subsequently four diets were tested at NARI in a large broiler grow out trial; 1) 50% sweet potato + 50% low energy concentrate; 2) 70% sweet potato + 30% low energy concentrate; 3) 50% cassava + 50% high energy concentrate and 4) 70% cassava + 30% low energy concentrate. Final body weights of birds fed diets 1 to 4 were 2.47, 2.38, 2.23 and 1.81kg respectively at 7 weeks of age. The grow out trial showed that diets 1 to 3 would be suitable for feeding birds at demonstration broiler grow out facilities established in the project in the highlands at CLTC's Banz Campus and in the lowlands at LDS's Mahalang's campus.

The critical issue as to whether the feeding strategy will be adopted by village farmers is to determine the profitability of village farmers using the concentrate strategy compared to feeding commercial diets. The first objective of the economic assessment is to determine the cost of locally milled broiler concentrate compared to the price of the commercially available alternative at several key sites in PNG. Spreadsheets of the cost of producing concentrate feed from mini-mills and profit of village broiler grow-out operations have been developed to meet this objective. The price of mini-mill concentrate derived from the mini-mill evaluation will be used in the spreadsheet for the village grow-out operation in that region (plus a cost for transport). Staff from NARI and UNitech are currently collecting feed ingredient costs, equipment costs and other fixed cost to enable the assessment to be completed.

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

Summary

Pyrethrum was introduced into PNG in the late 1950s and became an attractive cash crop for the highlands (~2000 metres). From the 1960s to the late 1980s the pyrethrum industry played a major role in sustaining the livelihood of some 65-85,000 people. Unfortunately, those marketing arrangements ceased when the factory closed in 1995. Although the factory has now re-opened the PNG industry has been unable to re-establish a market for its pyrethrum products. Now Botanical Resources Australia – Agricultural Services Pty Ltd (BRA) is willing to purchase PNG pyrethrum, but, a number of issues need resolving before PNG is able to re-commercialise the industry.

The PNG pyrethrum industry contacted BRA during November 2003 and there has been ongoing communications since that time. BRA, one of the two largest pyrethrum producers in the world, has supplied some 40% of world demand for pyrethrum products in recent years. In August 2005 BRA hosted a visit to Tasmania by a Government delegation from Enga Province in PNG, led by the Governor. During the visit the delegation signed a business agreement where the Enga Government agreed to supply exclusively to BRA, while BRA agreed to purchase a specified quantity of pyrethrum oleoresin at a set price for three years commencing in 2006.

This project will assist the PNG pyrethrum industry to re-commercialise into a profitable and sustainable industry. A secondary aim is to assess the plant physiological factors contributing to pyrethrum yield in Australia.

Project objectives are:

- to develop improved pyrethrum planting material and improved agronomic practices for PNG
- to assist in the adoption of improved pyrethrum production and extraction practices by the PNG pyrethrum industry
- to assess the plant physiological factors contributing to pyrethrum yield in PNG and Australia
- to improve the compatibility of PNG Pyrethrum extract and BRA refining processes.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Botanical Resources Australia - Agricultural Services Pty Ltd, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $801,657

Project Duration: 01/01/2007 to 31/12/2010

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

This project is progressing well with no problems and there are no expected variations to future activities. NARI and BRA/UTas/TIAR are progressing well with the agronomic studies and these studies are expected to be satisfactorily completed during this project. The results to date are very useful and it is quite likely that some of these studies will be suitable for publication in refereed scientific journals. The factory is now operating relatively efficiently and the laboratory is refurbished and equipped with the NIR and basic equipment. The NIR is working well and assays have been done on flowers collected by NARI as a part of the clone improvement study as well as commercially harvested flowers and the extracted oleoresin.

This project is having good impact on developing the capacity of the PNG partners. NARI researchers are benefiting from interaction with BRA and UTas/TIAR researchers on aspects of experimental

design and conduct, data analysis and reporting. The Kagamuga extraction factory operators are gaining experience in the use of laboratory equipment and in particular, the NIR as well as the safe and effective operation of the extraction plant. The extension staff are benefiting from the study tour to BRA in Tasmania as well as exposure to BRA senior staff during the regular visits to PNG by BRA senior staff. Of particular and unforseen benefits are the experiences and growth with Janet Yando, the female extension officer appointed by EPC as a part of this project.

The project is having very good impact in generating interest by smallholders to grow pyrethrum as a useful source of cash income and the funds already injected into the local community to date has been significant. There is a good opportunity to develop the PNG pyrethrum industry to the production levels of the 1970-1980's by the end of 2010. However, there is a need for the injection of some capital funds for the purchase of a tractor as well as seed money to assist growers to expand their production levels at a faster rate. The project team is currently working with the PNG National government to obtain more support and resources for the pyrethrum industry.

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

Summary

Many Pacific Island countries including PNG rely on subsistence farming and as such are vulnerable to the impacts of climate variability and climate extremes (floods and droughts). The ability of PNG to respond to these challenges will be largely influenced by their preparedness at local, institutional and national levels. An early warning system based on seasonal climate forecasts and building local capacity in use of this technology is seen as a major step towards meeting these challenges.

The highly variable climate also impacts greatly on the country's economy. In PNG, coffee production can generate almost thirty percent of the overall revenue for the country, and is the major cash-earning crop for the majority of people living in the rural areas. Statistics have shown that coffee production experiences significant fluctuations mainly due to either too dry or too wet conditions which are associated with the El Niño and La Niña phenomena. Understanding the impacts of climate on PNG's agriculture and the ability to predict these events with sufficient lead time for government and farmers to take remedial action and adapt to a changing climate is crucial to the long term sustainability of PNG's agriculture and the wellbeing of their people.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Queensland Environmental Protection Agency, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $149,710

Project Duration: 01/04/2008 to 30/06/2010

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

First progress report due in 2009.

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

Summary

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

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Centre for International Economics, Australia

Project Leader

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Collaborating Institutions

- Dr Eric Omura, Papua New Guinea

Project Budget: $149,830

Project Duration: 01/05/2008 to 30/08/2009

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

First progress report due in 2009.

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

Summary

As a part of the ACIAR project on “Improving Yield and Economic Viability of Peanut Production in PNG and Australia; (ASEM 2001/55)”, the critical role of peanuts in PNG farming systems was documented and high yielding peanut germplasm lines from ICRISAT were introduced and evaluated in multi-location trials in PNG. These trials resulted in identification of promising varieties with potential to yield 50-100% greater than the local varieties. The next logical step is to transfer the new varietal and associated management technologies to small holders and also to enhance the markets for, and marketability of, new peanut varieties in PNG.

The Australian peanut industry has highlighted a need to assess the potential for new markets for new peanut varieties and their products (i.e. especially high-oleic acid peanut oil which is comparable to sunflower oil). In Australia, spatial variability for yield and quality on broad acre farms is one of the major constraints to improving yield and profitability of commercial varieties. Recent work at DPI&F indicated that Near Infrared Reflectance (NIR) captured from aerial and satellite platforms can be effectively used to identify and monitor spatial variability (for disease, crop growth and maturity and aflatoxin risk) in peanut crops and to implement novel in-season management and harvesting strategies. NARI and Ramu Sugar are keen to apply this technology. In PNG, the application is more likely to be in terms of monitoring peanut crops (and other cropping systems), rather than intensive real time management, as is intended for Australia.

The objectives of the project are to:

- Ensure multiplication and supply of seeds of new high yielding peanut varieties to smallholders in Morobe and Eastern Highland Provinces of PNG.
- Demonstrate and monitor improved productivity of peanut using varietal, management, modelling technologies and farmer-participatory research approach in PNG.
- Develop and apply aerial NIR remote sensing technology to monitor spatial variability and improve productivity of peanut in Australia and investigate the scope for applying the NIR technology to monitor peanut cropping systems in PNG.
- Assess the potential of and feasibility to enhance marketability of new peanut varieties and products in PNG and Australia.

Project information

Overseas Collaborating Countries:
Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $844,422

Project Duration: 01/01/2006 to 30/06/2009

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

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

Objective 1: Having developed capability to undertake large scale peanut production, Ramu Sugar Ltd. has multiplied about 13 tons of selected short and medium duration peanut varieties during the 2006-07 season. About 4 tons of seed has been supplied for use in on-farm trials in the Eastern High Lands, Upper and Lower Markham Valley regions. The National Agricultural Research Institute (NARI) has procured pure seed of 22 short duration peanut varieties from Ramu Sugar for long-term storage at Bubia and Aiyura research stations.

Objective 2: During the 2006-07 season, a total of 12 on-farm trials (called 'seed

village' trials) were conducted in collaboration with local farmer groups in the Eastern High Lands, Upper and Lower Markham Valley. The seed village trials were aimed at demonstrating improved varietal and management practices on farmers' fields. Yield benefit from the improved practices (comprising row planting, seed treatment, fertilization and plant protection) ranged from being marginal to highly significant (up to 1.5t /ha) compared to local practice. Varietal responses varied across sites. There were marginal yield differences between local and new varieties in most locations although new varieties (ICGVs 94299 and 94341) had higher pod yields than local varieties at some locations in the Lower and Upper Markham regions. However new varieties had greater kernel yield in general due to better kernel to shell ratio and kernel size compared to local varieties. The trials have clearly demonstrated the scope for improving peanut production using improved practices and varieties at small holders' level in PNG.

Installation of the mini-column facility along with hands-on training provided in the Ist year enabled the project staff to quantify aflatoxin contamination independently. A total of 219 samples collected from 2006-07 seed village trials were analysed. Results showed that there was little aflatoxin contamination in the samples collected from the High Lands, while 60% samples from Markham valley recorded alarming levels of aflatoxin (>20 to 400ppb). The results agreed with the aflatoxin risk simulated by the APSIM peanut model which showed that in the High Lands aflatoxin contamination was low due to high rainfall and cooler temperatures, where as high aflatoxin risk in Markham samples was due to crops' exposure to end-of season droughts combined with elevated temperatures (which coincided mostly with late planting (beyond Feb) of crops).

Peanut field days and grower meetings organised by the project teams have generated significant awareness amongst growers about the new peanut varieties and management practices, including the harmful effects of aflatoxin contamination. Active participation of researchers and farmer groups in the on-farm trials resulted in the strengthening of linkages between farmers and collaborating research institutions in the target regions. A second survey was conduced on the role of women in peanut production in the Lower Markham Valley. The results confirmed the earlier findings that women in the Lower Markham have two major roles in decision making, one relating to cropping (i.e. crop and variety, time of planting) and the other related to childcare. Women also played a major role in sourcing peanut seed, weeding, marketing and planting. The survey has identified four major training needs for women i.e., soil fertility, booking keeping, pest/disease control and new strategies for peanut marketing.

Objective 3: During 2007, high resolution imagery (IKONOS satellite) was successfully captured over the three key locations including Aiyura, Gusap and Erap, encompassing 12 seed village trials as well as a number of village peanut gardens. NARI and Ramu staff exhibited greatly improved competency in the use of both GPS units and image analysis software ENVI as well as ground truthing of imagery. The project staff had hands-on training in interpreting the Imagery by ground-truthing crops in targeted locations and comparing crops spectral reflectance with yield performance.

In Australia, satellite images were captured over dryland peanut cropping areas of Wooroolin and Kingaroy, as well as the partially irrigated environment of Bundaberg and the fully irrigated system near the township of Texas, Queensland. Imagery processing followed by ground truthing of peanut crops has enabled accurate predictions of maturity, yield, foliar disease, soil constraints and irrigation efficiency to be achieved within trials and grower environments. Application of advanced image Analysis techniques in conjunction with the ground truthing of crops confirmed that the remote sensing has the potential to not only directly identify the spatial variability of crop vigour but also derive accurate prediction of pod yield and thus develop regional yield forecasts.

Objective 4: Although contracts for the peanut market scoping study in Australia and PNG were signed off in 2006, there has been a delay in implementing the study, as the contract for the PNG scoping study had to be re-initiated and a suitable candidate for conducting PNG scoping study had to be identified. A new suitable consultant has been identified for conducting PNG component of the market scoping study and the contract has been signed off in late 2007. Now that the two studies are progressing satisfactorily, it is expected that the reports of both Australia and PNG components will be completed by Aug 2008.

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

Root crops are traditional staple foods in PNG, and their vital contribution to food security in PNG is well recognised. However, the production of root crops, in particular sweet potato, is declining as a consequence of competing land pressure, shortening fallow periods, soil degradation and other factors such as pests and diseases. The ACIAR project cluster on root crops is designed with these constraints in mind. Its main focus is on identification and development of more productive and sustainable production systems based on root crops. Activities include efficient use of plant genetic resources; identification of promising nutrient, water, pest and disease management practices; and development of improved postharvest handling techniques. Capacity building and dissemination of promising technologies to farmers are critical and integral components of the program. During 2008/09 a program of activities on horticultural crops will be developed.

Projects:

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

Project Budget: $947,871

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

ACIAR Research Program Manager: Dr Caroline Lemerle

Summary

Sweet potato is a major staple food crop in Papua New Guinea, providing 43% of total dietary intake (as measured by weight and food energy). Annual production is currently 3 million tonnes with 75% of this crop produced in the Highlands. As a subsistence crop, most sweet potato produced in the Highlands has been used for home consumption as food and animal feed, but an increasing amount is being sold locally and to the markets in Lae and Port Moresby.

Postharvest losses from farm to market are high as a result of poor handling, storage and transportation techniques. Consultation with PNG partners have identified consumer preferences, marketing and postharvest management of sweet potatoes as priority research areas that need to be addressed. The Australian potato industry also faces similar postharvest losses, particularly through rot and breakdown during export. This project has two components, one in PNG focused on the sweet potato supply chain, and one in Australia focused on the potato supply chain. It aims to improve the livelihoods of farmers and other participants in the supply chains by improving marketing efficiency, postharvest management and value addition.

Project progress

First progress report due in 2009.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Canberra, Australian Institute for Sustainable Communities, Australia

Project Leader

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Collaborating Institutions

- National Agricultural Research Institute, Papua New Guinea
- Fresh Produce Development Agency Ltd, Papua New Guinea
- NSW Department of Primary Industries, Australia
- Rural Women's Development Initiative, Papua New Guinea

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

Summary

Potatoes are an important cash crop in Highland provinces. Commercial trade had reached 15,000 tonnes annually with a total value of Kina 10-15 million. This trade involved smallholders, many of who also rely on potato as a food staple and income source. Barter trade in potatoes is also widespread. An outbreak of potato late blight in early 2003 began destroying potato crops throughout the Highlands region. The cause is believed to be a virulent and new strain or strains of Phytophthora infestans, found in other potato growing regions throughout the world but not in PNG prior to the outbreak.

The highlands climate is ideal for late blight making control regimes vital, and also expensive. Fungicide spraying is needed every 3-5 days during potato cropping but the chemicals and equipment are beyond the purchasing power of most smallholders. Ensuring potatoes remain a viable crop for smallholders will depend on finding new seed stock that is resistant to blight and or effective and inexpensive control regimes.

The project is working towards these aims, specifically by:

- introducing, multiplying, evaluating and deploying late blight resistant potato clonal material into Papua New Guinea;
- developing safe and cost effective integrated late blight management strategies for existing and new potato cultivars.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Department of Primary Industries, Victoria, Knoxfield Centre, Australia

Project Leader

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Collaborating Institutions

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- International Potato Center, Peru
- National Agricultural Research Institute, Papua New Guinea
- Fresh Produce Development Company Ltd, Papua New Guinea
- Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea

Project Budget: $918,109

Project Duration: 01/11/2004 to 31/10/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 4 (01/06/2007-31/05/2008)

Late blight disease prevents smallholder farmers in Papua New Guinea (PNG) from growing the popular but highly susceptible potato variety Sequoia, which needs weekly fungicide sprays to be productive. The aim of the project is to introduce late blight resistant varieties, backed up with integrated disease management strategies, and the capacity to produce consistent quantities of quality seed potatoes of the new varieties for smallholder farmers.

The first field generation of four late blight resistant clones, bred by the International Potato Centre (CIP) and selected for farmer evaluation trials, has been harvested and will be grown on for a second generation before distribution. Selection of these clones was based on late blight resistance and favourable agronomic, cooking and flavour traits in field trials. A smaller quantity of seed of these clones is currently being multiplied for preliminary release to farmers for evaluation. Of the 59 CIP clones available, 29 have been screened so far and a further 21 as yet untested clones will undergo preliminary screening in field trials over the next 6 months. Further selections for farmer evaluation will be made when analysis of this year's trial data is completed.

Trials to date have demonstrated the effectiveness of the contact fungicide chlorothalonil in controlling late blight in Sequoia potato crops. However, additional fungicides, which have systemic and curative properties, are needed to improve late blight control, particularly in the young, rapidly growing crop. Protecting the young crop for as long as possible is critical in minimising

disease spread and yield loss. Advice on the most appropriate chemicals for PNG is being sought from European experts and chemical companies.

Seed potatoes of the variety Sequoia are currently in short supply in PNG because of limited supplies of tissue culture plants in the past. The output of plantlets has increased significantly over the past 12 months resulting in a steady supply of tubers being multiplied at Tambul. As a result, new supplies of commercial seed stocks will steadily increase from June this year.

Abstracts and posters of the results of fungicide and CIP clone evaluation trials in PNG were presented at the Third International Late Blight Conference in Beijing in April 2008. Dolf de Boer and André Drenth attended the conference, along with 152 other delegates from 34 countries. The CIP clone trial data from PNG will prove to be very relevant to potato production in tropical highland environments in other countries, such as Indonesia and East Timor. The pre conference workshop provided valuable information on standardised international procedures for research into late blight including fungicide and variety evaluation. A CIP training manual for Training of Trainers in the management of late blight presented at the workshop and can be adapted for training Village Extension Workers in PNG. Access to world experts on late blight management was invaluable in helping to focus project activities in PNG.

The Fresh Produce Development Agency has recently employed a full-time extension officer who will facilitate a farmer survey to identify constraints to growing potatoes, conduct farmer field school activities on late blight management using the CIP training modules, and assist with farmer evaluation trials of the selected CIP clones.

SMCN/2004/071: Reducing pest and disease impact on yield in selected PNG sweet potato production systems

Summary

In Papua New Guinea, sweet potato is the mainstay of the country's food security. Current production is 2.9 million tonnes per annum, worth an estimated $A700 million, and accounts for 63 per cent of the dietary energy of the population. Notwithstanding the dominance of the crop, both to the subsistence economy and increasingly as a cash crop on domestic markets, it is not without production problems.

Apart from climatic factors such as El Niño events, which cause major but temporary falls in production, farmers and scientists have noted a gradual decline in yields and the quality of tubers, the cause of which is not always obvious. This decline has implications for food security and needs investigation.

A visit to PNG to assess the situation in March 2005 identified a number of pests and diseases, along with crop physiology issues, that may be involved in the decline. The main aim of this project is to identify and address these problems.

The project is taking part in a constraints analysis being undertaken by ACIAR (SMCN 2005/045) into sweet potato production in Papua New Guinea. It is also taking cognisance of other ongoing ACIAR projects - ASEM/2003/010 on sweet potato yield improvement through varietal evaluation and another contract project (ASEM 2005/044) on marketing of sweet potato in Papua New Guinea. There is already a strong linkage with the pipeline PNG soil fertility project, including participation in that project's scoping study.

The project is building on results of past ACIAR-supported projects on sweet potatoes in PNG and other countries of the South Pacific, carried out by SAPRAD in association with CIP. The work complements existing sweet potato research of UNITECH (*Farmer participatory approach to selection of high- yielding sweet potato,* Ipomoea batatas, *varieties in Morobe*) funded under the AusAID Agriculture Innovations Grant Facility (AIGF). This project also links with a new CIP project, *Improving informal seed systems for sustainable sweet potato production under resource-poor farming conditions in Indonesia and the Pacific,* which ACIAR has accepted for funding.

Project objectives are to develop and test sweet potato pest and disease control strategies, and to increase dissemination and adoption of the pathogen-tested (PT) scheme as part of an IPM strategy for pest and disease control.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $905,775

Project Duration: 01/04/2006 to 31/03/2010

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

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

A major capacity building outcome for the project is the development of Pathogen Tested sweetpotato distribution capability in Papua New Guinea. To this end an insect proof propagation screen house was commissioned at Aiyura during the year. The first supply of Pathogen Tested plants were initiated from Aiyura in April. Seed stock of the virus indicator plant Ipomoea Setosa are now maintained at Aiyura with the first grafting onto the indicator plant for virus indexing occurring in late 2007. To complement the indexing process a heat cabinet for virus 'removal'

was ordered for delivery to Aiyura in mid 2008. Training in Australia on tissue culture and the Pathogen Testing process was delivered over a two week period for five PNG participants and two Solomon Islanders.

The first comparison trial for the project between Pathogen Tested and non Pathogen Tested planting material was established at Bundaberg in Queensland. The trial consists of 14 varieties with and without virus resulting in a total 28 treatments.

Development of an extension network for dissemination of information and Pathogen Tested (PT) planting material continued through the year. Two group workshops were held at Aiyura research station in Eastern Highlands Province: Group 1 consisted of Eastern Highlands participants and Group 2 Western Highlands. Participants were drawn from "commercial sweet potato farmers" and lead farmers and village extension officers from the Fresh Produce Development Agency. A participatory approach was used to deliver training in 'development and operation of a Pathogen Tested planting scheme for sweetpotatoes in PNG'. The use of mini insect proof screen houses as part of a PT scheme was highlighted. After the workshops the first insect proof screen house with Pathogen Tested planting material was established at the Highlands Agricultural College, Mt Hagen.

In a first stage to determine the impact of sweetpotato weevil on yields in Papua New Guinea three field trials were completed. Allied to this investigation the potential for using sweetpotato weevil pheromone for monitoring and use as a management tool was trialled at a 100 acre site in Rockhampton Queensland. Pheromone traps were placed on a 100 meter grid with over 80 000 male weevils being trapped and removed from the area. Trapping coupled with a spray program resulted in a significant reduction in the sweetpotato weevil population at the site. Applicability to PNG is to be tested.

Investigations into biological control of sweetpotato weevil identified a fungus in PNG as potentially efficacious in weevil control. The fungus was imported into Australia where a pure culture has been prepared and now awaits pathogenicity testing. Potential predatory ants on sweetpotato weevil were also collected in PNG and identified down to species level.

Literature reviews on Pest and Disease, Sweetpotato Weevil and Germplasm in Papua New Guinea were collated into one publication.

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

Summary

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

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

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

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

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

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

Project Leader

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Collaborating Institutions

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

Project Budget: $849,742

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

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

The project Hort/2005/134: The use of pathogen tested planting materials to improve sustainable sweet potato production in the Solomon Islands and Papua New Guinea is led by the East and Southeast Asia and Pacific regional Office (ESEAP) of the International Potato Center (CIP), in collaboration with main partner institutions in the Solomon Islands including the Ministry of Agriculture and Livestock (MAL) and the Kastom Gaden Association (KGA). The overseas collaborators include Queensland Department of Primary Industries and Fisheries (QDPI&F), and the Regional Germplasm Centre of the Secretariat for the Pacific Community in Fiji. This project summary covers approximately nine months of project activity, subsequent to the initial annual report submitted in September 2007.

The first objective of the project and primary focus of project activity during the period has involved the description and evaluation of sweet potato seed supply systems in Papua New Guinea and the Solomon Islands. In the Solomon Islands component, initial progress against this

objective has included the employment of a project coordinator and volunteer technical assistant in July 2007 and February 2008 respectively.

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

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

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

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

The second project objective is to introduce, refine and disseminate technologies for improved sweet potato production for small holders practising low-input agriculture. Progress against this objective has included planning and preparation for the establishment of "net houses" (igloos) to be used for evaluation centres for later sweet potato propagation.

Areas for the establishment of these structures are being arranged in association with KGA and MAL, respectively. Further progress towards the successful establishment of these centres has included advertisement for field technicians to monitor and regulate procedure in and around these sites. KGA and MAL have both initiated a process for recruitment of two technicians respectively.

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

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

Summary

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

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

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

Project Leader

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Collaborating Institutions

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

Project Budget: $131,000

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

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

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

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

Over 50 orange/yellow sweet potato varieties were collected and analysed (using high-performance liquid chromatography), as well as a selection of sweet potato leaf samples and other food crops. Collecting areas included the remote Santa Cruz Islands, Makira, Santa Ana, Guadalcanal, Western Solomons/Isabel (by Pita Tikai, KGA), and samples were also sent from Madang, PNG by World Vision. Project activity in PNG was limited in 2007 due to the leader's commitments to biofortification programs in several

countries, and also the project aim of being mostly Solomons-based.

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

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

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

The social research methods used included ethnography, key informant interviews, informal focus group discussions, free listing, pile sorting, photography, market survey and literature review. In addition, rare high-carotenoid banana germplasm was collected and transferred to Fiji for tissue culture. Names of the sweet potato and banana varieties, as well as characteristics, beliefs, practices, and traditional knowledge, and factors relating to production, marketing, consumption, and acceptability, all of which impact on the potential for promoting these crops, were explored. Plans are underway to initiate similar efforts on other islands of Solomon Islands and in PNG (in Madang Province, where the population has been identified as having the highest risk of vitamin A deficiency in PNG) in collaboration with World Vision and NARI. Suitable promotional materials (including posters of high-carotenoid local foods) are being developed.

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

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

SMCN/2003/010: Farmer evaluation and multiplication of sweet potato varieties on the North Coast of PNG

Summary

Papua New Guinea's (PNG) population is growing at a rapid rate, resulting in increasing land intensification, particularly for agriculture. As a result more productive crops are being planted, with sweet potato leading the way. The crop is now the most important for more than 60 per cent of the population, providing almost a third of total calories consumed. The possibility of future drought and increasing pressure on land use make the delivery of more productive lines important. In addition the wide range of agro-ecological zones in which sweet potato is grown makes the likelihood of finding varieties that are more suitable to localised conditions, offering yield boosts, high.

NARI has collected and trialled many crops and varieties that are likely to benefit farmers facing current yield constraints. A lack of clear line authority from National to provincial agricultural agencies has resulted in a sporadic extension of improved varieties. On PNG's north coast many communities stand to benefit from accessing improved varieties with more reliable output. Increased yields are likely to result in increased income, a reserve against drought and other disasters that often strike these areas. The main objective of this project is to evaluate and disseminate appropriate sweet potato varieties to the rural farming sector along the north coast of PNG.

To evaluate and disseminate appropriate sweet potato varieties to the rural farming sector along the north coast of PNG.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: World Vision Australia, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $930,601

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

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

Year 4 (01/04/2007-31/05/2008)

The original FE&MSP Project supported by ACIAR ended in November 2007. During the 3 year project, with the assistance of NARI, the project selected 16 different varieties that were then trialled at approximately 142 technician controlled sites during both wet and dry season. Two varieties were then discarded and the remaining 14 varieties (which included two farmer controls) were tested in approximately 350 farmer controlled trials, again during both the wet and dry season. Data was 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.

The one year extension of the Project allows for completion around the analysis and interpretation of technical data resulting from the above trials. It also provides an extended period of time to improve dissemination of findings and linkages with other projects and partners. Additionally, the extension provides the time to collate and share all of the above through both the workshop and final technical report.

Progress on Outcomes:

Outcome 1

Six Farmer Focus days were completed with all the qualitative results compiled and written up. Farmers were asked both agronomy and sensory questions. The initial findings (that will be fully incorporated in to the final report) indicate that women's preference for varieties is not significantly different from men's. In order of importance the agronomic characteristics farmer rate sweet potato on are: tuber size, smooth skin, number of tubers, skin colour and tuber shape. Sensory criteria show a preference for

sweet tubers, followed by firm flesh, good taste, soft flesh and non-fibrous content. It would seem that firm flesh is preferred when sweet potato is boiled, and soft flesh for when it is cooked in an open fire. Annex 1 presents some of the findings.

Outcome 2

With the generous support and assistance of Bob Mayer from Queensland Department of Primary Industry, the analysis of research data has started again. During April it was found that much of the data needed to be cleaned and presented differently for accurate analysis. For example, the original Technical Controlled on Farm Trials (TCOFT) data did not include an estimate for the weight of tubers damaged by rot, rats, weevils or beetles. When these are incorporated, yield of the best varieties increase by between 21 and 31 percent. Annex 2 shows that overall, there is a 23% yield increase when including an average of all the damaged materials. This is particularly high for TCOFT#1 because the crop was left too long before harvesting, and because it was the wet season.

The project tried to send planting material to Kerevat, where the material has originated from, to conduct a side-by-side trial. It was anticipated that the trial would reveal if the planting material from Madang had picked up a high viral load during the last three years. However, the virus load was so high, experts at the NARI Kerevat site were unable to clean the material. While this means the Output is not able to be conducted, it does conclude that viruses in Madang province are much higher than originally anticipated – and this is the most likely explanation for low yields.

Outcome 3

The Final Lessons Learned Workshop was held on 12-14 May. Preparation began for the workshop in November and December, with a reflection process to capture the themes that would be discussed. Seven key thematic areas were selected for the Lessons Learned event. These were:

- Community entry – selecting the project locations, communities and farmers
- Awareness and project start up – a community perspective
- Planning and implementation – from World Vision's side
- Farmer Participation
- Data collection
- Distribution of planting material
- Participatory Technology Development

In addition to these areas, a number of guest speakers were invited to the workshop to present on a range of other sweet potato projects. These included; the Orange Sweet Potato Varieties project in Solomon Islands, the NARI on farm trials and the Queensland Department of Primary Industries own work on multiplication of sweet potatoes. Presentations were also given on the preliminary findings of the FE&MSP project.

For dissemination of planting material to the wider community, nearly 800 direct farmers have received planting material. An estimated 1,400 have subsequently received material from these farmers.

SMCN/2004/067: Soil fertility management in the PNG highlands for sweet potato based cropping systems

Summary

Population growth in the PNG Highlands is around 2-3%, amongst the world's fastest-growing areas. Despite these high growth rates the area under agricultural production has remained relatively stable, with concomitant intensification of land use. This is placing unprecedented pressure on the land resource and on the long-term productivity of sweetpotatoes, the main staple.

A scoping study to analyse soil constraints in sweetpotato-based cropping systems and a survey of Highland farmers in 2005-06 (ACIAR Project SMCN/2005/043) confirmed that farmers are concerned and well aware of yield decline. They relate it to deteriorating soil fertility and the use of old sweetpotato varieties. A comparison of yields from gardens which had been fallowed and were brought into production recently ('new' gardens) with those from gardens that were due to go back under fallow ('old' gardens) revealed a 50% yield decline in tuber yield.

The results of the study confirmed that there is scope to improve productivity of sweetpotato-based systems in the Highlands by addressing soil fertility as a major factor in yield decline. This is underpinned by clear farmer awareness of the problem and interest in becoming engaged. The study also confirmed that several indigenous soil management options already operating in the PNG Highlands could be capitalised on and, if necessary, modified to enable permanent cropping.

The objectives for this project are:

- to assess and quantify soil and water processes in Highland soils
- to develop and implement improved nutrient and water management options for sweetpotato-based cropping systems
- to enhance soil research capacity in PNG.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Queensland, School of Land and Food Sciences, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $1,166,280

Project Duration: 01/04/2007 to 31/03/2012

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

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

The project commenced with an induction meeting held in June 2007. Participants included NARI and LDS project staff, Australian collaborators and visitors from DAL and the University of Goroka. We agreed on a work plan for the first objective of the project; to assess and quantify soil and water processes. Part of project objectives 2 and 3 overlap with the first objective and only a tentative timeline was developed.

Dr Gunnar Kirchhof visited NARI twice for a month in October 2007 and March 2008 to provide training on experimental design and operating of field equipment, assist with setting up sweetpotato nutrient omission and field trials, and design a project database.

Nutrient rate trials where the application rate of all of the basal nutrients were altered together have been conducted for the soils on all three sites. The aim of these trials was to determine an appropriate 'all' treatment for subsequent omission trials, in this way optimizing the capacity of the omission trials to identify deficient nutrients. The pot trial was run for around 5 weeks. The equivalent nutrient rates for a 'normal' rate were based on common fertiliser application rates.

Whilst the rate trial for the Aiyura site showed quite clearly that a 2x normal rate resulted in optimum growth, the results for

the Simbu and Tambul site were too variable and are currently being repeated. Nutrient omission trials were conducted using the same experimental procedure as the rate trial but using the 2x normal rate. An omission trial is based on omitting one nutrient at a time from the 'All nutrients' treatment, in this way identifying which nutrients may limit plant growth. Nutrient interactions are not identified in the omission trial approach.

On the Aiyura soil, only the minus Mo treatment was significantly different to the control. However, although the minus S treatment did not differ significantly to the control (P=6%), very distinct S deficiency symptoms were observed, i.e. the leaves were pale green to yellow in coloration. This indicated that, besides biomass, observations of plant nutrient deficiency symptoms are particularly useful.

On the Tambul soils N, P, S, Mn, Zn, Mo, Ni were significantly different to the 'all' treatment with minus S having the most significant impact on shoot production. On the Simbu soil significantly different to the control were: minus N, P, Ca, S, B and Mn with minus S and N having the most significant impact on shoot production.

A limitation of these trials is that nutrient availability under field condition may differ to those we observed under pot trial conditions. This is of particular importance for P owing to its interactions with mycorrhiza under field conditions. Hence field trials are needed to confirm pot trial observations. S-limitations were important in soils from two of the three sites supported the results from the scoping study. The confirmation that N-limitations were important, despite the high organic matter content of these soils, also supported our hypothesis about an imbalance between the release of N from the soil organic matter and plant demand for this nutrient; something which will be monitored and assessed during the field trials.

The exploratory survey to help design best-bet treatments for the process study was conducted in late 2007. Key findings were that farmers are not using improved fallows where they strategically establish fallow vegetation. Fallows are weedy regrowth; primarily voluntary grasses. Half of the farmers we interviewed were female, this is important for our on-farm trials and the inclusion of female farmers as decision makers. Green manure and compost are mainly grasses. They grow in the garden and there doesn't seem to be a lot of slash and carry. Availability of organic material for mulch and/or compost seems to be a major problem. The survey confirmed results from the pilot project that cropping cycles as well as fallow periods are becoming shorter.

Sweetpotato samples were collected during the exploratory survey. Total starch was analysed by the Centre for Nutrition and Food Sciences. The average starch content was 56% and there was no significant difference in total starch content between sweetpotato varieties.

All mother trials have been set up, completely instrumented and planted with sweetpotato. We used our 'at present' best management options as treatment allowing several important comparisons: opportunities to use of large Engan mounds outside Enga, effect of compost type and quality, evaluation of burning vs mulching and impact of short leguminous fallows or intercrops. These trials will run for at least the next two years.

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

Cocoa and oil palm

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

Projects

Project Number	Project Title	Page
ASEM/2003/015	Enhancing PNG smallholder cocoa production through greater adoption of disease control practices	39
ASEM/2006/127	Private sector / smallholder partnerships for improving incomes in oil palm and cocoa sectors in Papua New Guinea	41
PC/2007/098	Development of a mycoinsecticide to control Sexava pests in oil palm	42

Coffee

The PNG coffee industry supports over 350,000 families and earns K300 million ($A120 million) annually, but the consistency and reliability of coffee supply and quality has declined with the move to low-input management of the smallholder industry. Despite this general decline, premium PNG coffee retains a good reputation among customers and there is good scope to increase demand by improving marketing and quality. ACIAR's coffee program cluster aims to increase the profitability of coffee production for smallholders through optimising the cost and adequacy of production inputs, improving reliability of supply and quality, processing for quality and exploring a range of alternative marketing approaches.

Projects

Project Number	Project Title	Page
ASEM/2004/017	Assessment and improvement of quality management during postharvest processing and storage of coffee in PNG	43
ASEM/2004/042	Assessing and extending schemes to enhance incomes of PNG smallholder coffee producers via price premiums for quality	46
ASEM/2004/047 (multilateral)	Sustainable management of coffee green scales in Papua New Guinea (CABI)	48

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

Summary

Papua New Guinea's (PNG) cocoa sector supplies two per cent of the world market. Most of the total PNG crop comes from around 70,000 smallholders. The cocoa industry is worth an estimated K168 million (AUD 87 million) a year based on 42,000 tons production. Smallholders usually grow cocoa as a supplementary income source with few inputs and low costs reducing the impacts of market price fluctuations. One reason for the low input and production costs is the lack of applicability of cocoa management recommendations. These recommendations date back to when the plantation industry, not smallholders, were the dominant producers. When this industry sector was broken up smallholders emerged to take the place of plantation producers. The relevance of recommendations for management, including those for disease control, declined along with the plantation sector.

Productivity levels endured a similar an associated decline. One of the major causes was, and remains, diseases. Pod rot and canker caused by *Phytothphora palmivora*, vascular die back streak and pink disease are the main inhibitors to productivity. New technologies, management approaches and resistant breeds against diseases are available but not widely adopted, or even known, among smallholders. Improving adoption of these approaches would significantly increase productivity and with it the income on offer to smallholders.

Sustainably increase the profitability of smallholder cocoa production in PNG through the development of effective and affordable strategies in partnership with farmers, to develop effective management options of the major disease threats to production, by:

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

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $549,920

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

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

Year 2 (01/06/2007-31/05/2008)

This project facilitates the extension of Integrated Pest and Disease Management (IPDM) options to smallholder cocoa farmers using an on-farm participatory action research (PAR) and village-based extension approach. IPDM demonstration sites have been established in three districts in three provinces of Papua New Guinea: East New Britain Province (ENBP), Madang Province (MP) and North Solomons Province (NSP, or Bougainville). At each site, interviews with farmers and their families identified current constraints to cocoa production, as well as community goals and aspirations. Four IPDM management options were set up by trained 'model' farmers and 12 'extended' farmers at each site. The 12 extended farmers are trained by the model farmers. The extended farmers in turn each train more farmers. Training is hands-on, in the cocoa block.

Subprogram 3 projects: Improving smallholder returns from export tree crop production and marketing
Cocoa and oil palm

The model farmers record yield data and the incidence of black pod in each of their four IPDM option cocoa blocks. This gives the farmers 'ownership' of the trials, allows them to see the differences in yield between the four options and enables them to make more informed choices about the various options available. The data are collected regularly by the project team in each province and will be collated at CCI for analysis.

Field days were held in the Kokopo (Bitagalip Village) and Gazelle (Kareeba and Tavilo villages) Districts in ENBP and on Kaul 2 village on Kar Kar Island in November 2007. Over 400 farmers attended the field days in ENBP and around 100 attended on Kar Kar. The model farmers in the villages in ENBP demonstrated each of the techniques (pruning, canker painting, grafting etc) to the field day participants. Interested farmers can receive further training from CCI staff. A community resource centre has been built by villagers in Saidor in Madang Province as a training centre for the IPDM project.

Stakeholder meetings were held in ENBP, MP and NSP in November 2007 to assess the response to the IPDM technology and determine the future roles and responsibilities of the cocoa industry stakeholders. The key issues were the need for more extension staff, the certification of IPDM farmers, the desire for local government support to continue the extension and promotion of the IPDM technology and the lack of infrastructure in NSP.

IPDM options have been established at UniTech Lae by final year Agricultural Science students. The blocks continue to form part of the curriculum, and will form the basis for final year student projects in 2008.

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

Summary

The project aims to raise smallholder productivity and incomes in the oil palm and cocoa sectors through identifying, refining and promoting effective strategies for commercial sector partnerships with smallholders. Examples of commercial sector engagement are the provision of farm management advice/sale of inputs to smallholders, and joint venture companies between the commercial sector and customary landowner groups that entail various tenancy-type arrangements with conditions of land use.

The objectives of the project are to improve extension delivery through greater commercial sector engagement with smallholders, and to develop effective land-use agreements between the commercial sector and customary landowners. A core component of the project will be to implement innovative payment systems for productivity-enhancing inputs that accommodate the socio-cultural context of smallholder production.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Curtin University of Technology, Faculty of Media, Society and Culture, Australia

Project Leader

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Collaborating Institutions

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- PNG Oil Palm Research Association Inc, Papua New Guinea
- Cocoa Coconut Institute of Papua New Guinea, Papua New Guinea

Project Budget: $744,496

Project Duration: 01/01/2008 to 31/12/2011

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

First progress report due in 2009.

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

Summary

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

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Project Budget: $25,001

Project Duration: 01/03/2008 to 31/12/2008

ACIAR Research Program Manager: Mr Les Baxter

Project progress

First progress report due in 2009.

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

Summary

The PNG coffee industry supports 350-400,000 families and earns K300 million pa, but the consistency and reliability of coffee quality has declined with the move to the low-input management of the smallholder industry (>85%, the remaining plantation and 'block' production has received higher prices). Despite this general decline, premium PNG coffee retains a good reputation amongst customers and there is good scope to build demand for PNG coffee by improving marketing and quality.

PNG highlands coffee is of the *arabica* species, and the genotype x environment (G x E) potential is ideal for good quality coffee. However, critical postharvest steps from harvest, through wet processing, drying, grading, storage and transport, affect coffee quality and grade/sales potential, while further steps (roasting, grinding etc.) affect end-market opportunities for the coffee quality/grade received by the roaster.

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

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

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

Project objectives are to:

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

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $760,812

Project Duration: 01/01/2006 to 30/06/2009

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

The key activities outlined in the project proposal have been carried out as follows:

Assess postharvest system constraints to smallholder management of coffee quality and product consistency.

Surveys on coffee postharvest practices were carried out in 2006-2007 in three highland provinces. Those were Eastern Highlands Province, Simbu and Western

Highlands which are the major coffee producers in the country. The survey team interviewed 500 farmers living at an altitude between 1400 and 2000 m above sea level. The results were corroborated by a second smaller survey carried out in the East Highland Province, in collaboration with ASEM/2004/047 (Sustainable Management of Coffee Green Scales in PNG)

Following items were included in the survey questionnaire; general post harvest practice; time and labor input into post harvest operations; and the perspectives of exporters and roasters on quality improvement of coffee crop, and needs of farmers.

The survey data were analysed and resulted in the following overview of the prevailing postharvest practices among smallholders.

- The post harvesting techniques used by the smallholder farmers vary greatly from one location to another. A number of factors affect the techniques and methods used. Women carry out most post harvest work (65%) besides doing their household chores.
- The smallholder farmers pick most of the cherry once they started the harvesting seasons irrespective of their maturity due to need of fast cash and fear of theft.
- For those who do not own a coffee pulper, there are different ways and methods used to pulp cherries. The latter are often substandard. Delay in pulping that affects the quality is a common problem in smallholders as well.
- Fermenting process is sometimes rushed or prolonged out of ignorance of the resulting poor quality.
- Drying techniques vary. Some farmers use tables while other spread beans on ‘canvas’ (plastic sheets) on the ground. Storing of beans during drying process is either in a family house or in a separated storehouse.
- A number of smallholders relay on hired labor for harvesting and to a lesser extend for postharvest processing.
- The quality of smallholder coffee is affected by the poor understanding of the relationship between postharvest techniques used and quality. Most of the farmers show their concern about low price obtained for their coffee due to its poor quality.
- Most farmers are eager to adopt new technology if and when one is develop, however their obvious constraint will be finance.

As a result of the survey, the project teams (CIC and UNSW) are developing and testing solutions to system deficiencies, with particular attention to improvement of drying and storage.

The project teams continue work started in 2006 on the evaluation of the criteria for coffee quality assessment in PNG. In 2007 an increasing number of experiments have been carried out at the CIC laboratory in Aiyura near Ukarumpa. The thermophysical laboratory has been constructed, most of the analytical equipment supplied and training provided. An eco-processor for coffee, model UCBE 500 M, was supplied and installed in April 2007 and CIC technical staff trained. A sensory evaluation of coffee processed with the eco-processor vs. traditional wet processing method using cupping tests showed no significant difference in taste between coffee processed by either of the methods. In view of these results, three more eco-processors have been imported to PNG by private processors. The CIC staff provided training to these processors. The introduction of eco-processors is likely to contribute towards improvement in coffee quality (reduction in processing time) and towards environmental protection as this method requires only 1 litre of water per kg of green coffee vs up to 50 litres using traditional wet processing method.

Sun drying trials of wet processed coffee (de-pulped and de-mucilaged with the eco-processor) have been conducted in 2007. The conclusions are as follows:

- A range of drying surfaces was tested. The difference in rate of drying between the surfaces was of the order of 20% or less.
- Elevation was tested. This factor was not significant.
- Mesh surfaces generally performed better (approx 20%) than solid surfaces.
- The notable exception was the existing method (blue plastic canvas on ground) which performed equally well with all methods.

This suggests that the method of sun drying has little effect on drying rate. If true,

this further indicates that the drying rate determining step for coffee beans is not surface evaporation, but internal diffusion. Mesh and elevation may improve the first few hours of drying, but experimentally have little overall effect. Then the only way to improve drying rates (sun, solar or mechanical) is to raise the internal bean temperature.

With regard to the sensory evaluation, the CIC laboratory in Aiyura is in the process of setting up its own cupping tests in line with those at CIC in Lae.

- Devise and implement strategies for the adoption of system improvements

The testing of eco-processor is progressing. A second unit (with a petrol engine) is currently being imported in order to carry out demonstration trials at village level.

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

Summary

Coffee growers in PNG fall into two broad sectors; the estate comprising block-holders and plantations and the smallholder sector. Of the two it is the smallholder sector that produces the majority of PNG's coffee. Smallholder farmers account for 85 per cent (56,100 tonnes) of production. The estate sector has been in decline for most of the past two decades, producing only 9,900 tonnes.

The export of coffee is an important component of PNG's economy. Ten per cent of all PNG exports are from coffee, generating five per cent of GDP. Almost 400,000 rural households grow coffee and 20,000 people are employed in the processing and marketing areas. Despite this importance PNG's reputation as a quality producer, which underpins export market access is under question. The estate sector built this reputation for some of the world's leading quality coffee. However, the decline of the estate sector has corresponded to the decline in reputation that PNG coffee is now experiencing. As this reputation has dipped it has brought price premiums down with it.

Some smallholder producers are still commanding price premiums, through their involvement in several collaborative marketing arrangements. Producers are establishing long-term working relationships with suppliers paying premiums in return for quality coffee. This is a departure from current practices of paying a single price regardless of quality, guaranteeing a return to smallholders but in turn sacrificing overall quality. The alternative arrangements of groups of growers linked to processors suggests that tying price to quality can deliver quality when the working relationship provides sufficient market signals and information. Supply chain improvements also help, returning some of these benefits to smallholders.

To improve the economic returns to PNG smallholder coffee producers and the industry, through delivering a more consistent and higher quality product, by examining arrangements linking smallholders and processors.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Curtin University of Technology, Agribusiness Marketing (Horticulture), Australia

Project Leader

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Collaborating Institutions

- PNG Coffee Industry Corporation, Papua New Guinea

Project Budget: $541,502

Project Duration: 01/04/2005 to 30/09/2008 (Project extended from 01/04/2007 to 30/09/2008)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

Year 3 (01/04/2007-31/05/2008)

Australian team members were advised in February 2007 of the need to review the time frames associated with the project as a result of the mid year general elections. As a result, training programs did not commence until October 2007. Given that many of the training programs are best conducted during the coffee season, a formal extension until September 30, 2008 was sought and granted.

It is becoming more apparent that without adequate support, collaborative marketing groups will struggle in PNG. With the need to aggregate the product until sufficient parchment has been accumulated, smallholder producers must forgo the opportunity to sell to roadside traders for immediate gain in the expectation of receiving higher returns. In the highly volatile international coffee market and without first establishing some rules and standards which govern the processing of cherry at the village level, there is some doubt as to whether higher prices will be achieved. Furthermore, and perhaps more importantly, there is an immediate need to re-establish community values and sanctions, particularly with regard to discouraging cherry theft and to address the root causes of social disorder. Personal viability training, introduced under this project, has been instrumental in facilitating

more enduring relationships within the community and between group members. It is also becoming more evident that the more successful groups will be those which are based around traditional haus lines and where there is some enduring linkage with a trader, processor or exporter. These partnerships are more likely to result in farmers being able to access working capital, technical information and market information and are essential where smallholders seek accreditation under either organic or Fairtrade coffee.

To facilitate the delivery of training to the various farmer groups, a number of training modules have been prepared and/or updated. The delivery of the training modules was greatly facilitated by conducting a number of workshops with selected service providers to ensure that all parties understood what the project was seeking to achieve. A pre-training questionnaire was administered to each of the pilot groups prior to the commencement of the training to provide a benchmark and a post-training questionnaire will be administered at the conclusion of the training. Under the current system of training, the major impediment limiting the capacity of the project to replicate is the lack of sufficient service providers to deliver the training programs and an acute shortage of staff at Aiyura to administer the process.

There is, among the exporters, a widespread concern that yields will continue to decline unless farmers are encouraged to plant more coffee or to rehabilitate more trees. While high prices are resulting in a greater investment, the increasing incidence of cherry theft is providing a significant disincentive. Higher prices have been received as a result of a reduction in the discount. However, this cannot be attributed to any marked improvement in quality, but is more the result of exporters adjusting to the market dynamics and selling only what coffee they have available. With the margins for Y grade deteriorating, exporters are endeavouring to move more PNG coffee into the specialty market. As a result, there is increasing evidence to suggest that minimal intervention is required in the supply chain. With coffee farmers in PNG receiving as much as 78% of the fob Lae price, competition between the exporters to secure both cherry and parchment is intense and there is no evidence of any cartel or price fixing arrangements. Hence, in the current market, there is little evidence to support or to encourage direct marketing by smallholder coffee growers in PNG.

After much initial enthusiasm, it is evident that fewer exporters are pursuing accreditation under Starbucks Café Practices. It is not only too difficult to meet the standards imposed by Starbucks, but many of the criteria do not apply to PNG, and other specialty coffee buyers are paying more than Starbucks to secure premium PNG coffee.

Nevertheless, there is a growing awareness of the opportunity to secure higher prices through a number of sustainable quality assurance programs including Utz Kapeh, Oxfam, Rainforest Alliance and bird friendly coffee. With such an abundance of quality management systems, there is some doubt as to whether there is any need for a generic PNG quality assurance system.

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

Summary

Coffee is the largest earner of foreign exchange within the PNG agricultural sector (> 43% of PNG agricultural exports and 10% of total exports). Primarily produced by smallholders in the highlands (397,000 families and 85–90% production in 2003), with few management inputs, productivity is hampered by inadequate pest management as well as by deficiencies in quality management and marketing.

With the latter problems being addressed by other ACIAR projects, this project is developing and fostering uptake of biological control and other integrated strategies for coffee green scale (CGS - *Coccus celatus* De Lotto and *C. viridis* (Green) (Hemiptera:Coccidae)), a pest capable of causing up to 50% yield reduction in some instances. The scale insects colonise leaves and stems of the plant, closely adhering to them. Although immobile, they avoid attack by natural enemies because they are guarded by ants that drink their honeydew, the partially digested plant juices that flow quickly through the digestive tract of the pest. The quality of bean is likely to be affected by CGS, since quality depends on bean density and during ripening there is often a critical shortage of nutrients to fill the bean sufficiently before harvest comes.

In consultation with smallholders, the PNG Coffee Industry Corporation (CIC) has confirmed the urgent need to develop and introduce integrated management systems for coffee green scale. Currently the European Union (EU) is supporting CIC to develop capacity for research in IPM and biological control of CGS, but this effort (provision of facilities, equipment, training, access to parasitoids) needs the complementary R&D supplied by this project.

Objectives of this project are:

- to document baseline information on the distribution, impacts, biology and control of CGS in the coffee-growing zones of PNG
- to evaluate biological and other control methods of CGS, taking into account grower information
- to develop regional and national strategies for wider evaluation and implementation of CGS control.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: CAB International, UK

Project Leader

Sean Murphy

Collaborating Institutions

- PNG Coffee Industry Corporation, Papua New Guinea
- University of New South Wales, Australia

Project Budget: $621,960

Project Duration: 01/04/2006 to 31/03/2009

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

The incidence and impacts of coffee green scales (CGS) and their associated insects were recorded via major surveys in Eastern Highlands Province (EHP) in 2006/2007. The results of this study show that CGS infestations were highest at 1500m, above and below this, infestations were much lower. The impact of this data is not restricted to this project alone, but can be used in conjunction with future studies targeting areas of high infestations.

There is scientific evidence that the removal of ants reduces scale infestations. It is thought that ants provide key services that augment CGS populations. Since 2007 an additional research station study examined the effect of excluding ants on CGS infestation levels. This has shown that excluding ants reduces infestation rates over time.

A survey examining the species diversity, abundance and distribution of ants and CGS has been completed. The mortality of young coffee trees and shoots is greater than mature infested coffee trees. The effect on young trees is compounded when CGS are attended by ants because ants can prevent natural enemies thereby increasing CGS survival leading increased damage. It has become clear that native

ant species do not appear to be a major issue. Exotic invasive species appear to be the problem. This could impact on future biological control as some of these ant species maybe very closely associated with CGS and their biocontrol agents. Further investigations will be needed, specifically the provenance of these ant species, their ability to harass CGS predators and to asses the potential for the control of ants.

The intention was to import available parasitoids from Australia and switch them to coffee in the quarantine facility, planned for September 2007. A 'citrus system' should have been ready, but due to a CGS population crash it was not. After reviewing the situation a series of possible causes were identified and have been rectified.

The Aiyura quarantine facility will be the receiving unit for biocontrol agents so a thorough review of its current status was carried out. Whilst it was clear that significant progress had been made the persistent problem of inadequate light and overheating was evident. After extensive reconstruction the resulting facility has been significantly improved in terms of light and temperature control, and can accommodate purpose built cages. Despite excellent progress the facility was still not of a suitable quarantine standard in terms of security. However, structural improvements and procedural changes have been implemented.

Preliminary and large scale socio-economic surveys to examine current control methods, constraints to farmers and available support services were completed in 2006/2007. Participatory extension is the main tool used by PNG farmers. However, there is clearly a lack of knowledge amongst farmers on CGS, especially smallholders. Many farmers were unaware of what CGS was, and as such this lack of knowledge made it difficult to determine control methods and yield loss. This indicates that there had been a shortfall of information from extension programmes. Extension officers are interested in learning, and can be advised on new approaches tailored to local needs.

Both human mediated and natural pathways appear to be involved in CGS spread. Nurseries grow and supply seedlings which happen to be infested with CGS. Simple sanitation could provide clean plants available for farmers. However, another common route is via infested farms where farmers propagate their own seedlings. With the natural spread possibly being mediated via invasive ants, both ecological and anthropogenic issues need to be resolved.

In order to provide more clarity from these surveys a scoping study was conducted in late 2007 to pave the way for more detailed case studies. These principally address; farmer practices, awareness and extension, and incorporate the whole family. The scoping study was conducted on the sites that were identified as high risk zones.

Farmers were first briefed on CGS in 1994, by the Coffee Research Institute. However, limited knowledge and educational material negated its impact such that until recently, farmers were not aware of CGS as a problem. Extension officers also learnt from the previous project surveys and are now able to provide information during the current Participatory Rural Appraisal Programme (PRAP). Recent exposure to awareness material has enabled farmers to identify CGS as a problem such that they discuss CGS with PRAP officers. As such, the PRAP programme has improved the relationship between CIC-Extension and farmers. This programme has helped them to understand CGS and clearly shows that the current extension has great potential.

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

Fisheries and aquaculture

Inland fish farming is expanding rapidly in PNG, with an estimated 11,000 smallholder farmers contributing an annual production valued at $A2.5 million. Key constraints include poor fingerling supply compounded by inefficient distribution channels (which limit the availability of seed to farmers), the high cost and limited availability of suitable feeds, and a general lack of aquaculture husbandry skills and knowledge. The projects are interlinked and collectively aim to improve the productivity of fish farmers in inland PNG in the following ways: by increasing the supply of fingerlings to farmers; improving available feeding options, including on-farm feed production and the development and distribution of simple formulated feeds based on locally available materials; conducting dedicated training programs and strategies to increase farmer skills in pond husbandry; and investigating alternative culture species, with an emphasis on promising indigenous fish and crustaceans.

Projects

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FIS/2006/138	Developing aquaculture-based livelihoods in the Pacific islands region and northern Australia	55

Forestry and agroforestry

ACIAR's PNG forestry project cluster promotes the development of a smallholder and community-based plantation industry with high-value species. This would be based on significant domestic processing, involving both portable sawmills and static production facilities, together with enhanced production of non-timber forest products and services. In conjunction with this research, there is support to improve management of secondary forests for the ongoing sustainable production of timber.

Projects

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FST/2004/050	Value-adding to PNG agroforestry systems	57
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FIS/2001/083: Inland aquaculture in PNG: improving fingerling supply and fish nutrition for smallholder farms

Summary

Aquaculture is a growing industry in Papua New Guinea (PNG). Fish can provide both income and food protein but in inland areas rivers do not have a high number or diversity of species to support these needs. Farming of fish, or Aquaculturing, is one avenue through which increased supply can be reached. A previous ACIAR project examined the aquaculture industry in PNG. A survey of 313 farms, as well as hatcheries, institutions and markets, revealed approximately 11,000 active fish farms. This was almost double the 6,000 estimated to be in operation prior to the survey's findings. Three types of farms are in operation, those of newcomers to the industry who are yet to harvest, established farmers and pioneers of the industry. One thing most have in common is never having received training in aquaculturing fish.

The survey, together with a workshop of key stakeholders, identified the main issues for research to support the industry. Of these issues two will be addressed in this follow-on project. Demand for fingerlings to fill ponds is extensive, with current supply able to meet only 10 per cent of this. The distribution network for the industry is a limiting factor, along with protocols to support hatchery operations and broodstock management. Nutritional feeds to help rear fingerlings are also in short supply. Manufactured pellet feeds expensive and leave smallholders seeking other material. Local ingredients that support the growth of fish and utilise materials that can be prepared on-farm are also needed to support the industry's expansion.

The project is working to improve the productivity (and profitability) of smallholder fish farmers in inland PNG. The long-term outcome will be increased dietary protein and better nutrition for farmers, their families and inland communities.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Western Sydney, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $774,751

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

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

In April, 2007 the project team met and reviewed the project. As a result, the distribution of remaining funds and objectives were revised. Since then, the team has made substantial efforts to get back on track. We welcome the return of Ms Hopa Simon to the position of Technical Officer at Aiyura. Mr Wally Solato successfully moved from Aiyura to Goroka and is now working with NDAL. Mr Billy Kerowa and Mr Douglas Kawa both continue at Erap. The Australian Volunteer, Mr Kevin Lange, who was stationed at HAQDEC in Aiyura for two years (2006-8), completed his stay in PNG in March 2008.

All Technical Officers have prepared workplans for their station and off-station work. These workplans vary from officer to officer - topics include studies with formulated fishmeal-based feeds, GIFT broodstock production trials, fingerling trials, polyculture and trials with sex-reversal of GIFT fish. The feed-manufacturing machines arrived at all stations (Goroka, Erap, Port Moresby, Banz and Aiyura) and the Officers are working to get them installed and, in some cases, they

are now successfully producing pelleted fishmeal-based feed.

The publication by ACIAR of our book: "Aquaculture in PNG: Status of freshwater fish farming" was printed and distributed by ACIAR. Farmers who participated in the study, NGOs, Officers and all interested parties received copies. The monograph is available on the ACIAR website.

A strategic review of the operations of the Highland Aquaculture Development Centre (HAQDEC) at Aiyura, was carried out by the team in July 2007. This review gave the staff at Aiyura a chance to express themselves to the project. Judging by follow up trips in October 2007 and May 2008, the staff at Aiyura is working well towards substantial improvements. Major improvements include: repair of the inlet canal to the water reservoir and replacement of timbers of monk – now the reservoir is full for most of the year.

Two good second-hand vehicles were purchased for the project and are operating in Morobe and Eastern Highlands Provinces. The vehicles were paid for from the project's funds. Fuel, registration and maintenance are provided by the project and at the conclusion of the project in 2009, the two vehicles will become the property of NDAL.

The project has extended its "Fish Husbandry Package" at four workshops at demonstration farms have trained 250 new farmers in the last 12 months. The workshops are based on getting the farmers to carry out activities over three days. The team brings GIFT fingerlings (and common carp) so that the farmers can stock ponds once they have constructed them (usually 3 to 6 months later). Workshops were held as follows:

- February 2007 - Workshop Avini Village, Koruo Fish Farm (80 fish farmers attended).
- November 2007 - workshop at Asai village, Madang Province (75 attended)
- November 2007 - Bihute workshop, EHP (35 prisoners attended)
- May 2007 – Bihute Training workshop EHP (40 prisoners & officers attended)
- November 2007 – Banz workshop, WHP (52 attended) (5 days workshop)
- February 2008 – Kundiawa workshop, Simbu 75 attended
- November 23 – 26th 2007 - Faiyantina Workshop (33 participants)
- February 2007 - Workshop Avini Village, Koruo Fish Farm (80 fish farmers attended).

The farmers are very keen to learn at these workshops - they always ask for a return visit in 12 months to reinforce and renew their training so that they get more skills and confidence. The farmers in greatest need are in remote regional areas away from the big towns. Some farmers walk for 2 days to attend. We have found that the workshops have a high impact and within 12 months, the farmers generally have a surplus of GIFT fingerlings.

The project has started working with 20 co-operator farms – 10 in the highlands and 10 in the lowlands. Preparations are being made for off-station work with trial feeds and other aspects of the "Fish Husbandry Package". While the project's activities at Co-operator farms are yet to reach our planned goals, there were three visits by officers to initiate the work at the farms, as follows:

- June 2007 - visited 10 lowland co-operator farms
- July 2007 - visited 10 highland co-operator farms
- September 2007 - visited 10 highland co-operator farms

At the University of Western Sydney (UWS), Australia, an experiment on polyculture (carp and redclaw) was carried out – it showed that this could be a useful culture system for reducing the over-breeding of prolific breeders (such as redclaw crayfish and GIFT). This may have application in PNG – Billy Kerowa started work to apply the results to polyculture with common carp and GIFT fish. Also at UWS, several strains of bacteria were isolated which have interesting enzyme profiles which may be useful for aquaculture.

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

Summary

Lack of animal protein in the diet of people in the highlands of PNG is the main factor in poor children's development. Attempts to diversify animal protein sources for highland communities have met with limited success, but aquaculture has the potential to provide dietary protein in inland areas of PNG, with small or no cash inputs. Native species have a number of advantages for culture in the area – they are pre-adapted to local conditions, and are familiar to and favoured by the people. Recently, many aquatic species have become extinct in parts of Western Province, but at present there is no capacity in PNG to culture native species. Indeed, the potential of native species in aquaculture has largely been overlooked.

In Western Province, particularly in the densely inhabited north-west sector near the Ok Tedi mine, there is a crucial need to develop alternative livelihoods for mine-affected communities when the Ok Tedi mine closes in 2012. An ACIAR exploratory project (C2003/149) found interest and willingness from Ok Tedi Mining Ltd (OTML) Food Security Programs, Western Province (WP), National Fisheries Authority, and local pond owners to commit resources to native fish/crustacean aquaculture.

This project builds on the work of the earlier exploratory project which identified several promising candidates for aquaculture, and opportunities and partners for hatchery development.

Objective 1 is to develop robust hatchery and growout techniques for indigenous fish species to support sustainable aquaculture in both Queensland and PNG.

Objective 2 is to evaluate potential of pond-based crustacean aquaculture in PNG and Queensland, building on techniques already developed in Queensland for these species.

Objective 3 is to assess the acceptance by farmers of the new species and techniques, and develops appropriate husbandry packages.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $781,587

Project Duration: 01/06/2006 to 30/06/2011

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 2 (01/06/2007-31/05/2008)

Progress in PNG

The development of robust hatchery and growout technologies has progress well. Ok Tedi Mining Limited (OTML) has completed the temporary hatchery with attached laboratory at Kiunga. There have been 2 spawning attempts of sooty grunter with one being successful. The juveniles from this spawn have been stocked into a pond.

Broodstock collections are continuing for sooty grunter, sleepy cod (mudfish), fly river herring and redclaw. Ponds have been stocked at OTML and Western Province Government research station, Lowlands Aquaculture Research, Development and extension Centre, (LARDEC) with:

- Sooty Grunter
- Catfish
- Mudfish
- Redclaw
- Fly River Herring

The OTML & LARDEC staff has been working together for the broodstock

collection. As OTML has experienced reduced staffing, these trips are beginning to strain the system. An alternative has been to buy fish from the local villages. This has worked out well but depending on the species can jeopardise the health of the fish. Collection of male fish for the sooty grunter, catfish and the sleepy cod has been a problem. With most fish being collected turning out to be females.

Ponds have been completed and stocked at Samagos (LARDEC), although there has been major leaking with the holding dam. The main leak is situated under the wall, where old wood has decayed. This area has been excavated out and relined with clay. Bentonite has been shipped from Queensland, which will fix the smaller leaks.

Training at Freshwater Fisheries and Aquaculture Centre, Walkamin, (QDPIF) hosted one OTML and one LARDEC staff member for practical training and capacity building. The training was designed to reflect the requirements and interests of the participants to enhanced aquaculture in PNG. The topics covered were:

- Spawning of sooty grunter & catfish (500 juvenile catfish and 60,000 sooty grunter stocked) including broodstock handling, induction, live food culture, egg collection and handling daily routines and monitoring of the animals
- Feeding protocols
- Redclaw harvest
- Pond preparation and plankton sampling
- Daily water quality routine
- Basic microscope handling
- Calibration of water quality equipment
- Demonstration of 2 different electro-fishing methods: boat and backpack
- Visit to local barramundi and redclaw farms
- Visit to other research centres
- System design of targeting hatcheries.

Progress in Australia

At JCU research has been conducted on the Australian strain *M. rosenbergii* for reproductive seasonality, conditioning, fecundity as well as inducing out-of-season spawning and the attempt to close life cycle. The inducement of out-of-season spawning by temperature and photoperiod manipulation has achieved relatively limited success. The life cycle of Australian strain *M. rosenbergii* has been fully closed in 2008. All broodstock for the hatchery production this year came from the growout pond at DPI.

Development of hatchery techniques focused on comparison of ‘green water’ vs ‘clear water’; effects of different algae concentration in ‘green water’ culture; artemia enrichment vs. no enrichment; different larval stocking density and water exchange schemes as well as optimal procedure for acclimation of postlarvae to freshwater. A trail on culture of larvae at extra low salinity of about 3-5 ppt has shown that it has limited impact on larval survival.

The 4 hatchery runs, produced 65,000 PL has shown a trend of lower survival (40-65%), higher cannibalism rates and longer larval duration (25-35 days) as compared to last year, whether this is a result of inbreeding would need further investigation. Nevertheless, the result is still compatible to that reported for Malaysian strain.

Broodstock collection for JCU was undertaken by FFAC which commenced in September resulting in males only being trapped. The collection trips continued into December, trying for females. Females were difficult to find and very small in size. Collection methods consisted of traps and backpack electro fishing. Numerous different baits were used including chicken necks, tinned cat food and sweet potato.

Bioremediation

Due to the high number of fish mortalities experienced from the extreme cold winter, we had to restart this project. All remaining fish were harvest and pooled together. They were then redistributed to all 6 ponds. New fish were purchased to increase the densities that were evenly distributed to all 6 ponds. The plants ponds were inoculated with duckweed at the same time. As the duckweed didn’t survive and all local farms had huge amounts on their ponds, we collected water sample for a baseline of nutrients levels. The findings indicated that the nutrients in the ponds at FFAC were lower than on the farms. Once the nutrients increased in the FFAC ponds, the duckweed has maintained its density.

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

Summary

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

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

The final project review in November 2006 concluded that the mini-project concept had been successful and its results were 'impressive'. This project arose from a specific recommendation that ACIAR commission a follow-on project to extend the mini-project concept.

The overall aim of the project is to support economically, socially and environmentally sustainable aquaculture in the Pacific Islands region, and to assist indigenous aquaculture in tropical Australia. Importantly, the project will support the SPC's Regional Aquaculture Strategy and supplement the R&D activities of the SPC Aquaculture Action Plan. Its specific objectives are to:

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

Project information

Overseas Collaborating Countries: Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu

Commissioned Organisation: James Cook University, School of Marine and Tropical Biology, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $1,229,662

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

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

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

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

1. Half pearl ('mabe') production in Fiji, Tonga and Kiribati
2. Culture of juvenile sandfish (*Holothuria scabra*) for restocking and sea ranching trials in Fiji

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

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

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

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

FST/2004/050: Value-adding to PNG agroforestry systems

Summary

After more than 30 years of unsustainable commercial exploitation of PNG's natural forests, the contribution of forestry to PNG's local and national economies will soon start to diminish significantly. International markets for a number of high-value tree species that are already grown or have potential in PNG are expected to remain favourable, therefore market opportunities will start to emerge for planted trees of these species. This mirrors the transition from a natural to a planted forest resource base that has been experienced elsewhere.

Everywhere in PNG tree growing and management of trees are incorporated into both traditional and modern farming systems. However, because there has been little incentive to focus on species of commercial forestry value, often such species are ignored. Where a critical mass of resource can be established, commercial tree-growing appears a good prospect for landowners with limited income-generation alternatives.

This project is framed in these contexts. It draws from current knowledge, including prior ACIAR work, to assist PNG landowners in targeted pilot regions to adopt commercial tree-growing. An ACIAR pilot project earlier identified suitable candidate regions and partners, together with tree species and production systems.

The project aims to foster the adoption of commercial-scale high-value tree growing by landowners of PNG. Its objectives are to:

- define commercial tree production systems for priority species in pilot regions
- assess landowner decision-making in the context of candidate tree species and production systems
- develop business models and strategies to facilitate adoption, in conjunction with investment and implementation partners - businesses, government, NGOs & CBOs (community-based organisations)
- implement strategies in the pilot regions in conjunction with landowners and investment and implementation partners
- communicate project knowledge and learning to interested parties outside pilot regions.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $912,087

Project Duration: 01/04/2007 to 31/03/2011

ACIAR Research Program Manager: Dr Russell Haines

Project progress

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

Progress in the first year of ACIAR Project FST/2004/050 was focused on establishing the foundations for the intensive research phase of the Project, beginning in June 2008. Principal activities comprised the Project Inception Workshop, held at ANU, Canberra, 22-23 May 2007; three visits to PNG collaborators by the Principal Project Scientist, Dr Hartmut Holzknecht, and one by Project Scientists Dr Michael Blyth and Mr Braden Jenkin; the conduct of pilot field research by Project John Allwright Fellow and PhD scholar Kulala Mulung, in conjunction with Ramu Agri-Industries; the establishment of linkages with associated ACIAR Projects (FST/2004/009 – Improved germplasm for forestry and agroforestry; FST/2004/055 Domestication of *Canarium indicum*; FST/2006/088 Promoting diverse fuelwood production systems); and the

compilation of relevant background information and research outputs by Project Scientists and collaborators (in addition to those named above: Dr Michael Bourke, ANU; Dr Andrew McGregor, Koko Pacific; Dr Ruth Turia; PNG University of Technology; Dr Lastus Kuniata, Ramu Agri-Industries; Mr Don Yakuma, Ok Tedi Development Foundation).

The principal outcomes of the first year of the Project were:

- confirmation of the most likely candidate species identified in the Scoping Study for the pilot study regions. These are the short-rotation *Acacia mangium* and *Eucalyptus pellita*, which are considered as baselines for comparison; the medium-rotation exotic*Tectona grandis*; and the longer-rotation native species *Canarium indicum* and *Instia bijuga.* Existing investments in rubber (*Havea brasiliensis*) in Western Province led to its inclusion in financial analyses as a comparator species
- development and refinement of field survey methods to assess landowners' attitudes to commercial tree growing
- agreement of the Project workplan for the intensive research phase beginning in June 2008.

Project communication activities were focused on those between Project partners, and with other key PNG stakeholders. A paper describing the Project was accepted for presentation at the most relevant international forum, a meeting of IUFRO Working Party 3.08 *Small-Scale Forestry*, in June 2008.

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

Summary

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

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

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

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

Project information

Overseas Collaborating Countries: Papua New Guinea, Solomon Islands

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

Project Leader

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Collaborating Institutions

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

Project Budget: $634,571

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

ACIAR Research Program Manager: Dr Russell Haines

Project progress

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

During the 2007-2008 period, the work of the *Canarium indicum* (Galip nut) Domestication and Commercialization Project has centred on exploration and characterization of genetic resources of the species. Project staff have visited remote areas of five Provinces of PNG (Bougainville, East New Britain, mainland and island areas of Madang, New Ireland and West New Britain). Within the five provinces, 13 villages were selected for prospection, tree selection / collection. Additionally, meetings on project objectives and activities were held with local authorities and landowners. After these consultations, almost 10,000 individual fruits (nuts) were collected from more

than 400 trees and transported to the NARI Lowlands Agricultural Experiment Station in Keravat. Project staff carried out detailed measurements of fruit characteristics of these samples, based on which they identified trees in each population with superior commercial characteristics, particularly for traits related to kernel size. One or more return visits to each site were made in order to finalize tree selections with local landowners (this involved both screening of preliminary selections and also to supplementation with selections made by the farmers themselves). Subsequently, trees in each population were pruned in order to stimulate production of branches suitable for marcotting (air-layering), i.e. to permit their propagation. This prospection and collection work is an important first step in planned domestication. It was initially scheduled for the first year of the project, but could not be carried out as planned, due to key staff members being temporarily assigned to deal with the cocoa pod borer emergency.

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

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

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

Summary

Fuelwood is a crucial, but undeveloped, component of the domestic economy of PNG. Fuelwood plantations could directly enhance smallholder income and provide a pathway for rehabilitating grasslands. The main aim of this project is to establish a national fuelwood economy based on woodlots and agroforestry systems. Underpinning objectives are to describe and quantify the national fuelwood market, to establish in both lowland peri-urban and highland rural regions a range of fuelwood production systems as pilot projects, and to establish a community of practice which will ensure the wider adoption and long-term development of fuelwood production. Such a system will enable creation of business opportunities to supply a growing fuelwood market while at the same time providing opportunities to produce other products including seedlings, poles and fodder.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $923,079

Project Duration: 01/01/2008 to 31/12/2011

ACIAR Research Program Manager: Dr Russell Haines

Project progress

First progress report due in 2009.

FST/2006/120: Increasing downstream value adding in PNG's forest and wood products industry

Summary

PNG's forest industry, based largely on the export of logs from primary forests, is a significant contributor to the national economy. But accessible forests are rapidly being depleted, and the earnings from the logging of primary forests will dwindle over the next 10–15 years. Still, PNG enjoys some significant competitive advantages in relation to the production of timber, and it is possible to envisage a major national industry based substantially on smallholder agroforestry plantings and community-based management of secondary forests. In particular, if coupled with a significant domestic processing industry, this industry could become a much larger contributor to the national economy than the current log export industry.

The aim of this project is to provide the foundation for a more extensive and more sophisticated domestic timber processing industry in PNG – by exploring the development of various products and designs based on solid wood and veneers, by examining the potential for value chains to integrate advanced processing with production of timber in smallholder agroforestry systems and community-managed secondary forests, and by enhancing capacity in timber processing training, education and R&D.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Melbourne, Faculty of Land and Food Resources, Australia

Project Leader

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Collaborating Institutions

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- Timber and Forestry Training College of the PNG University of Technology, Papua New Guinea
- PNG Forest Products Ltd, Papua New Guinea
- PNG Forest Research Institute, Papua New Guinea
- Village Development Trust, Papua New Guinea
- University of Technology, Papua New Guinea
- PNG Forest Industries Association, Papua New Guinea

Project Budget: $682,818

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

ACIAR Research Program Manager: Dr Russell Haines

Project progress

First progress report due in 2009.

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

Biosecurity

Many of the agricultural pests and diseases that ravage staple food crops, plantation and horticultural crops in PNG are of biosecurity concern to Australia. ACIAR has a cluster of projects that investigate better ways to manage these pests and diseases using systematic and environmentally sound methods. These include integrated pest/disease management techniques and biological control options, some of which are focused on pest/disease surveillance, quarantine risk and incursion management. The projects aim to reduce crop losses and increase quality and productivity, providing better incomes for farmers. All projects have capacity-enhancement components.

Projects

Project Number	Project Title	Page
AH/2006/157	Improved biosecurity for animal diseases in Papua New Guinea	64
HORT/2005/136 (multilateral)	Mitigating the threat of banana Fusarium wilt: understanding the agro-ecological distribution of pathogenic forms and developing management strategies (IPGRI)	65
PC/2003/029	Management of potato late blight in Papua New Guinea	68
PC/2003/042	Fruit fly management in Papua New Guinea	70
PC/2004/064	Biological control of ‘mile-a-minute’ (Mikania micrantha) in Papua New Guinea and Fiji	72
PC/2006/017	Management of Eumetopina flavipes: the vector of ramu stunt disease of sugarcane in Papua New Guinea	74
CP/2006/063	Integrated pest management for Finschhafen disorder of oil palm in Papua New Guinea	76
CP/2006/114 (multilateral)	Managing cocoa pod borer in PNG through improved risk incursion management capabilities, IPM strategies and stakeholder participatory training (CABI)	77
CP 2007/111 (multilateral)	Incursion prevention and management of coffee berry borer in Papua New Guinea and East Indonesia (CABI)	79

Sustainable resource management

Projects

Project Number	Project Title	Page
FIS/2005/096	Assessment of the impact of the PNG purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices (FADs)	80
FST/2004/061	Assessment, management and marketing of goods and services from cutover native forests in PNG forests	82

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

Summary

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

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $599,037

Project Duration: 01/05/2008 to 30/04/2012

ACIAR Research Program Manager: Dr Doug Gray

Project progress

First progress report due in 2009.

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

Summary

Fusarium wilt disease caused by *Fusarium oxysporum* f. sp. *cubense* (*Foc*), one of the most devastating plant diseases, is a major concern for banana-producing countries. The damage potential of the disease is exemplified by the devastating outbreaks that occurred in Latin America in the 1950s, which destroyed whole plantations and led to the disappearance of the Gros Michel cultivar from the commercial dessert banana industry.

Foc is conventionally classified into four pathogenic forms known as 'Races'. Race 1, which destroyed the Gros Michel plantations, also attacks many local cultivars in Asia; Race 2 affects specific cooking bananas. The particularly virulent 'Tropical' Race 4 affects a wide range of cultivars including Cavendish, and has caused substantial production losses for commercial and subsistence farmers in Indonesia, Taiwan, Malaysia and the Northern Territory of Australia.

Foc is also classified into vegetative compatibility groups (VCGs) - 21 clonal lines of VCG are known to exist. Recently, severe infections were reported on Cavendish plantations in China and the Philippines. The variation in pathogenicity within the conventional races highlights the need for more precise characterisation of variability based on VCGs, and a better understanding of the relationship between pathogenicity and *Musa* (banana and plantain) diversity.

Foc cannot be effectively managed with fungicides and the disease remains over a long period in the soil. The early and accurate diagnosis of the disease, prevention of its spread and the deployment of management strategies are, therefore, of utmost importance. The impact of the disease has prompted the Banana Asia Pacific Network, BAPNET, to call for support for increased research into pathogenic variability, host-resistance and sustainable disease management methods to alleviate the losses caused by this disease.

The objective of this project is to carry out a comprehensive survey and characterisation of *Foc* pathogenic forms and to develop national strategies for disease exclusion, containment and management, identifying a package of management tools through participatory approaches and exploiting existing networks to enable 'fast-track' adoption of effective measures.

Project information

Overseas Collaborating Countries: Indonesia, Papua New Guinea

Commissioned Organisation: Bioversity International, Philippines

Project Leader

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Collaborating Institutions

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- National Agricultural Research Institute, Papua New Guinea
- National Agriculture Quarantine and Inspection Authority, Papua New Guinea
- Agency for Agricultural Quarantine, Indonesia
- Queensland Department of Primary Industries and Fisheries, Australia

Project Budget: $600,566

Project Duration: 01/06/2006 to 31/05/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 2 (01/06/2007-31/05/2008)

Our project objectives, regarding mitigating the threat of banana Fusarium wilt remain the same.

Survey, Collection and Characterization

Indonesia

The survey and collection of samples within the framework of the CP/2005/136 project is complete in eight major Indonesian banana producing provinces (See Section 2). One hundred and eleven Fusarium oxysporum f.sp. cubense (Foc) pure isolates were sent to QDPI&F for VCG (Vegetative Compatibility Group) and DNA

characterization. The Foc isolates came from 16 different banana varieties.

To fully map the Foc distribution in Indonesia, provinces under the Indonesian / ACIAR bilateral project (CP 2004/034) are being surveyed to complement surveys under project CP/2005/136. ITFRI is generating pure isolates from the samples collected, to be sent to QDPI&F for VCG and DNA characterization.

VCG analyses at QDPI&F show that 73 out of the 111 isolates gave positive VCG results, belonging to several VCG groups (See Section 2). 44 out of the 73 VCG-positive isolates showed specific results for VCG 01213/16, the VCG that is associated with the virulent Tropical Race 4 (TR4). The remaining 38 isolates were negative in the VCG tests. There was a confirmation of VCG 0126 on a wild banana, Musa schizocarpa, collected from Papua Province. Nine new Musa accessions were collected from Central Kalimantan, North Sulawesi and Papua.

Papua New Guinea (PNG)

Survey and collection activities are being conducted in PNG. Six field surveys, yielding 36 samples were completed between September 2007 and February (See Section 2) These were sent to QDPI&F for testing. Fusarium wilt-like symptoms were uncommon in these surveys, indicating that Fusarium wilt disease is not yet well established in PNG. QDPI&F tests show that none of the 36 samples from PNG was infected with Fusarium wilt disease. Survey and collections are scheduled for June 2008 in Sundaun, which borders with Papua, where TR4 has been previously reported.

A huge diversity of local bananas was observed in Manus (See Section 2).

Taxonomists from the survey-team collected new banana accessions from Manus (10) and Western province (6). New germplasm accessions are important potential sources of resistance for specific banana diseases, including Foc TR4. The accessions were added to the existing germplasm collection of NARI in Laloki.

Development of rapid molecular diagnostic tool

A key project objective is to develop an accurate and rapid diagnostic molecular technique test for Fusarium wilt. One hundred and two Foc-positive isolates from Indonesia were studied by extracting their DNA, using a commercial DNA plant extraction kit BioSprint Tissue Lyser. Tests showed that 47 samples were found to be positive for TR4, 35 to be negative, and 20 samples gave inconclusive results. The accuracy of the test on the 102 samples was computed at 80.39%, which is relatively low, thus test procedures will yet have to be refined.

Virulence-Host Resistance Test

Four local banana varieties, Ambon Kuning, Barangan, Kepok , and Raja Sere, have been initially tested for resistance to the six following VCGs (See Section 2): 01213/16, 0123, 0120, 01218, 0126, and 012415. The project will be conducting virulence tests on a total of 25 selected wild and cultivated banana varieties to eight VCGs (See Section 2). Preliminary results showed Fusarium wilt symptoms such as vascular discolouration, chlorosis and wilting were observed on inoculated plants. Other tested local varieties showed common symptoms such as yellowing and wilting of leaves even three months after inoculation. Despite some observed corm infection. VCG01213/16 was noted to be most virulent among the tested VCGs. These results indicate differences in disease resistance/susceptibility of the various test varieties, and possibly differences in virulence of the different VCGs.

On-farm disease management demonstration trials

The farmer co-operators participatory planning workshop assessed farmers' practices in banana production and disease management, as well as options for management of Fusarium wilt disease. From this workshop, the following are the 'best-bet' options for Fusarium wilt management: The use of:

- disease-free planting materials obtained from tissue culture (TC) propagation
- varieties tolerant or resistant to Fusarium wilt such as FHIA-17, FHIA-21, FHIA-25, GCTCV 119, Ketan-01, and one susceptible variety Ambon Warangan (Cavendish subgroup
- burning rice-hull on infected mats or spot eradication
- good agronomic practices
- a biological control using Pseudomonas fluorescens, adopted from the farmers' field-school program

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Biosecurity

- demonstration plots were established in Lampung, Central Java and Malang, East Java in cooperation with farmer-co-operators.

The farmers were trained on the use of clean planting materials from banana tissue culture and the management of tissue culture seedlings for field planting. One important aspect of the project is to introduce a sustainable TC delivery system to small-scale farmers sourcing from commercial laboratories. Private tissue culture laboratories (22) producing banana meriplants were identified across Indonesia. A meriplant delivery system and a management protocol for village nurseries is being developed.

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

Summary

Potatoes are an important cash crop in Highland provinces. Commercial trade had reached 15,000 tonnes annually with a total value of Kina 10-15 million. This trade involved smallholders, many of who also rely on potato as a food staple and income source. Barter trade in potatoes is also widespread. An outbreak of potato late blight in early 2003 began destroying potato crops throughout the Highlands region. The cause is believed to be a virulent and new strain or strains of Phytophthora infestans, found in other potato growing regions throughout the world but not in PNG prior to the outbreak.

The highlands climate is ideal for late blight making control regimes vital, and also expensive. Fungicide spraying is needed every 3-5 days during potato cropping but the chemicals and equipment are beyond the purchasing power of most smallholders. Ensuring potatoes remain a viable crop for smallholders will depend on finding new seed stock that is resistant to blight and or effective and inexpensive control regimes.

The project is working towards these aims, specifically by:

- introducing, multiplying, evaluating and deploying late blight resistant potato clonal material into Papua New Guinea
- developing safe and cost effective integrated late blight management strategies for existing and new potato cultivars.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Department of Primary Industries, Victoria, Knoxfield Centre, Australia

Project Leader

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Collaborating Institutions

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- International Potato Center, Peru
- National Agricultural Research Institute, Papua New Guinea
- Fresh Produce Development Company Ltd, Papua New Guinea
- Papua New Guinea Cocoa and Coconut Institute, Papua New Guinea

Project Budget: $918,109

Project Duration: 01/11/2004 to 31/10/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 4 (01/06/2007-31/05/2008)

Late blight disease prevents smallholder farmers in Papua New Guinea (PNG) from growing the popular but highly susceptible potato variety Sequoia, which needs weekly fungicide sprays to be productive. The aim of the project is to introduce late blight resistant varieties, backed up with integrated disease management strategies, and the capacity to produce consistent quantities of quality seed potatoes of the new varieties for smallholder farmers.

The first field generation of four late blight resistant clones, bred by the International Potato Centre (CIP) and selected for farmer evaluation trials, has been harvested and will be grown on for a second generation before distribution. Selection of these clones was based on late blight resistance and favourable agronomic, cooking and flavour traits in field trials. A smaller quantity of seed of these clones is currently being multiplied for preliminary release to farmers for evaluation. Of the 59 CIP clones available, 29 have been screened so far and a further 21 as yet untested clones will undergo preliminary screening in field trials over the next 6 months. Further selections for farmer evaluation will be made when analysis of this year's trial data is completed.

Trials to date have demonstrated the effectiveness of the contact fungicide chlorothalonil in controlling late blight in Sequoia potato crops. However, additional fungicides, which have systemic and curative properties, are needed to improve late blight control, particularly in the young, rapidly growing crop. Protecting the young crop for as long as possible is critical in minimising disease spread and yield loss. Advice on the most appropriate chemicals

for PNG is being sought from European experts and chemical companies.

Seed potatoes of the variety Sequoia are currently in short supply in PNG because of limited supplies of tissue culture plants in the past. The output of plantlets has increased significantly over the past 12 months resulting in a steady supply of tubers being multiplied at Tambul. As a result, new supplies of commercial seed stocks will steadily increase from June this year.

Abstracts and posters of the results of fungicide and CIP clone evaluation trials in PNG were presented at the Third International Late Blight Conference in Beijing in April 2008. Dolf de Boer and André Drenth attended the conference, along with 152 other delegates from 34 countries. The CIP clone trial data from PNG will prove to be very relevant to potato production in tropical highland environments in other countries, such as Indonesia and East Timor. The pre conference workshop provided valuable information on standardised international procedures for research into late blight including fungicide and variety evaluation. A CIP training manual for Training of Trainers in the management of late blight presented at the workshop and can be adapted for training Village Extension Workers in PNG. Access to world experts on late blight management was invaluable in helping to focus project activities in PNG.

The Fresh Produce Development Agency has recently employed a full-time extension officer who will facilitate a farmer survey to identify constraints to growing potatoes, conduct farmer field school activities on late blight management using the CIP training modules, and assist with farmer evaluation trials of the selected CIP clones.

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

Summary

Fruit flies are the major pest of horticulture in the South Pacific. They lay their eggs into fruit and vegetables where the larvae cause direct fruit damage. In PNG, where growers are generally smallholders who routinely market produce that is excess to family/village needs, fruit infestation levels routinely range above 20%. Better fruit fly management is an ACIAR-listed PNG priority.

This project is a continuation of the previous ACIAR project CS2/1996/225, *Identification, Biology, Management and Quarantine Systems for Fruit Flies in PNG*. The previous project identified PNG's pest fruit flies and susceptible crops, and this new project is now packaging the outputs of the earlier project, devising practical actions for fruit fly management in both PNG and Australia.

Research for this project is a true collaborative effort between Australia and PNG. On the Australian side scientists are developing new generation protein baiting and mineral spray oil application technologies for extension to both Australia and PNG. The PNG team is developing the trapping, cultural and physical aspects of fruit fly control, for extension to PNG and also for use in Australia. PNG trials are being conducted as formal on-station and on-farm trials, with farmer participation and on-farm demonstrations.

Building on methods and contacts established in CS2/1996/225, this project is using a farmer participatory technology development (PTD) approach, focusing specifically on:

- confirming status/importance of fruit flies in selected crop production areas, by analysing data from the earlier project to identify temporal and spatial distribution of PNG pest fruit flies for each area /crop/season combination targeted in this project
- trialling and implementing various technologies for fruit fly control
- enhancing fruit management skills of extension workers and farmers.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: NSW Department of Primary Industries, Australia

Project Leader

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Collaborating Institutions

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- National Agricultural Research Institute, Papua New Guinea
- University of Western Sydney, Australia
- Queensland University of Technology, Australia
- Pacific Adventist University, Papua New Guinea
- Fresh Produce Development Agency, Papua New Guinea

Project Budget: $740,007

Project Duration: 01/04/2006 to 31/03/2009

ACIAR Research Program Manager: Mr Les Baxter

Project progress

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

An impact assessment survey has been conducted in eight locations over three provinces in Papua New Guinea (PNG). The survey has shown that farmers recognise fruit flies as major pests, but don't generally use control strategies because they don't fully understand the ecology of the insect. These results indicate that more information should be provided to farmers to help them understand how to better manage fruit flies. It is planned that this survey will be conducted at least once more during the course of the project to gauge the impact that the project has on farmer's awareness and management strategies for fruit flies.

A bagging experiment on guava fruit conducted earlier in the project demonstrated that bags made from old newspapers provide complete protection from fruit fly infestation when they are applied to fruit prior to maturity. Replicated trials with capsicum (3 locations) and banana (1 location) are currently being conducted in PNG. These trials compare the efficacy of different management

methods, including protein bait spraying and male annihilation technique (MAT). The results from these trials conducted in PNG will form the basis of fruit fly management strategies to be developed for each of the different regions being investigated in the project. The results from these trials will also be used to educate farmers on the management options that may be available to them and to produce extension materials. In Australia, work has continued on the development of improved female fruit fly lures and traps.

The replicated trials are visited weekly by technical staff and this provides an opportunity for ongoing communication with local farmers. Farmer training has been conducted by

NARI and FDPA staff in locations where the experiments, fruit fly trapping and fruit sampling have been taking place. The training covers topics including the ecology of fruit flies, different fly species, and different management options. It is planned that demonstration trials will be set up later in 2008 to help continue this training. Written extension materials will also be prepared. Students at PAU and technical staff from the collaborating agencies have also been involved in a number of training workshops.

A draft manuscript for submission to a peer-reviewed journal has been prepared that reports the relationship between the distribution and abundance of populations of five economically important fruit flies (data collected in previous project CS2/96/225) and environmental factors, such as altitude and annual rainfall. It is anticipated that this paper will be published in the near future.

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

Summary

Papua New Guinea and Pacific Island Countries (PICs) are becoming increasingly concerned about the occurrence, spread and impact of weeds on the region's food crops (such as taro, sweet potatoes, yams, bananas, papaya and green vegetables) and cash crops (cocoa, vanilla, sugarcane, kava and oil palm). By affecting yields, some introduced weeds directly affect food security and income and impact on the natural ecosystem functions. However, most Pacific islands lack the technical capacity to prevent the introduction of serious weeds or manage them effectively.

This project is tackling one of the Pacific's most important weeds (as ranked by the 2004 meeting of Pacific Heads of Plant Protection) - mile-a-minute (*Mikania micrantha*). Mikania is a major problem throughout the Pacific. Solomon Islands, Niue and Vanuatu have infestations, but it is particularly severe in PNG and Fiji.

In PNG, mikania is already one of the major weed invaders of farms in several provinces. It can form a dense ground cover, out-competing other ground species such as sweet potato and yams, or can grow up and over garden crops, such as taro, papaya and lowland coffee, completely smothering vegetation and causing loss of production and localised death of these crops. In plantations, mikania can grow up into the canopy of plantation trees, completely smothering them, interfering with harvesting of coconuts, oil palm or cocoa pods. The weed has also become a significant weed in young cocoa and vanilla plantations in East New Britain, and young oil palm plantation in West New Britain.

In Fiji, mikania is a serious weed in mature taro and kava plantations and is one of the major weeds in sugarcane farms on both Viti Levu and Vanua Levu. In many areas, farmers cannot afford costs of manual or chemical weed control.

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

Project information

Overseas Collaborating Countries: Fiji, Papua New Guinea

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

Project Leader

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Collaborating Institutions

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

Project Budget: $579,018

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

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

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

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

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

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

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

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

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

Summary

The sugarcane disease Ramu stunt is a devastating and quarantinable disease spread by the planthopper, *Eumetopina flavipes* Muir, and has caused losses of up to 60% on sugar cane in PNG. The planthopper is also present in some areas in northern Australia but the disease has not yet established. The aims of this research are to develop an integrated management program for the planthopper and to enhance the protection of the Australian sugarcane industry. This will be developed through surveys, control trials, establishment of quarantine guidelines and cane grower education.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Bureau of Sugar Experiment Stations Limited, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $149,641

Project Duration: 01/06/2006 to 30/11/2008 (Project extended from 30/06/2008 to 30/11/2008)

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 2 (01/06/2007-31/05/2008)

This ACIAR-funded work complements a PhD project funded by the Sugar Research and Development Corporation (SRDC) led by Kylie Anderson; the ACIAR-funded project addresses the sugarcane planthopper *Eumetopina flavipes* and its host plants in Papua New Guinea. Ms Anderson is the leading researcher in the ACIAR-funded work.

There are three main objectives associated with the ACIAR-related work; these are: i. determining the impact of *E. flavipes* at Ramu Agri-Industries and development of management practices that minimise insecticide usage and re-infestation from wild canes, ii. establishment of local quarantine guidelines and the education of indigenous residents in prevention of the spread of the insect to other regions / countries, and iii. Investigation of the role of *Saccharum* host usage in re-colonisation of the pest / the potential of alternative species to host *Eumetopina flavipes*.

There have been some major obstacles to some of the programmed research for the last 12 months. This relates particularly to the work to be conducted by Ramu Agri-Industries (formerly Ramu Sugar Limited). On their Estate, outbreaks of *Sesamia* stemborer and ratoon stunting disease (RSD) have meant that resources have been re-directed to reduce commercial losses from these organisms. This has led to little further work on the *Eumetopina* x varieties aspect of the research. Ramu Agri-Industries have expressed firm commitment to completion of the research but will need a project extension to complete the work.

The last of the planned project surveys was completed during the period – this included the Torres Strait and northern Peninsula area of Cape York.

The *E. flavipes* specimens collected during the PNG survey (year 1) were initially subjected to DNA analysis in the laboratories of James Cook University (Cairns campus) for identifying population-level variation. Population differences could reflect ethnic population movements, and feeding preferences in PNG *E. flavipes* populations. As mentioned in the previous annual report, a range of published primers failed to amplify the Cytochrome oxidase 1 (CO1) region of *E. flavipes* mitochondrial DNA. After method variation, the process was completed and the CO1 region was amplified by PCR. However analysis sequences revealed that the required variation did no occur in this region. There was a requirement therefore for mitochondrial DNA screening and for the development of species-specific microsatellite primers. This is a specialist task. Griffith University were requested to assist in the development of the assay

primers. A selection of *E. flavipes* individuals from PNG and northern Australia has been sent to Griffith University for this purpose. Griffith University has indicated they will be in a position to provide the primers within three months. The assays are being developed to shed light on the relationship between the pest and host, as well as re-colonisation potential provided by the various hosts at different locations. *E. flavipes* assays will also provide direct evidence on how *E. flavipes* populations interact among geographic locations. Such variation is expected to provide information on the historical movement of the pest between locations, as affected by human movement of the *Saccharum* host(s).

The AGRF Adelaide Laboratory has completed analyses on *Saccharum* host leaf samples, where genetic fingerprinting technology for the Australian sugar industry has been developed. Molecular analyses will provide information on differences and variation in the four *Saccharum* species collected: *S. officinarum*, *S. robustum*, *S. edule* and *S. spontaneum*. How this analysis relates to the *Eumetopina* assays is yet to be determined because of the delay in the development of micro-satellite primers. The required analyses will take an additional eight weeks following the development of the micro-satellite primers.

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

Summary

Oil palm has proved to be well suited to the high-rainfall lowlands of PNG and, on fertile soil, yields are among the highest in the world (approximately 60% above the world average). Oil palm is well suited to support rural development in relatively isolated regions because of its high value, year-round production and the fact that it is easily harvested (by hand) about every two weeks giving continuity of income to smallholders. Once established, palms are productive for at least two decades.

These benefits are, however, are threatened by the spread of Finschhafen disorder (FD), which was first observed on coconut palms near Finschhafen, Morobe Province, Papua New Guinea (PNG) in 1960 and now threatens the production of oil palm. Its spread has been dramatic – its presence in West New Britain (WNB) was not noted until March 1994, but the suspected cause, a planthopper (*Zophiuma lobulata*) was present and has since spread to be found widely on oil palm in WNB and mainland PNG.

Two serious outbreaks, each of over 100 ha, have been reported at Embi Estates and Milne Bay Estates. Pilot research has show that three-year-old palms may have 15-18 leaves affected and that severe necrosis and cracking may result from the presence of as few as four adult *Z. lobulata.*

FD is, therefore, of serious concern to the industry. But the lack of an understanding of the cause of the disorder prevents implementation of effective, economically viable and sustainable management to limit its spread and minimise its impact in affected areas.

The aim of this project is to protect the viability of the important oil palm industry and the economic and social benefits that flow from production on plantations and smallholdings. Objective 1 is to develop a comprehensive biological understanding of the causes of FD, while Objective 2 is to develop preliminary methods for its control.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Charles Sturt University, School of Rural Management, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $399,950

Project Duration: 01/03/2007 to 28/02/2010

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 1 (01/03/2007-31/05/2008)

The overarching aim of this project is to protect the viability of the important oil palm industry and the economic and social benefits that flow from production on plantations and smallholdings in Papua New Guinea. Specifically, the work concerns Finschhafen disorder (FD), a problem that was first observed on coconut palms near Finschhafen, Morobe Province, Papua New Guinea (PNG) in 1960, and is now a potential threat to the production of palm oil. The very limited amount of previous research suggested that FD may be a direct consequence of feeding by a native PNG planthopper Zophiuma lobulata Ghauri (Hemiptera: Lophopidae). Previous studies however, pre-dated the availability of molecular biology methods that enable detection of possible plant pathogens. Z. lobulata belongs to a group of insects widely implicated in vectoring plant pathogens in other crops.

A full time Postdoctoral Fellow (Dr Catherine Gitau) has been recruited to the project from the International Centre for Insect Physiology and Ecology in Kenya. She, and the project leader (Prof Geoff Gurr), have visited PNG to work with Charles Dewhurst Head of Entomology at

PNG Oil Palm Research Association. Molecular biology and taxonomic expertise have been contributed by the ongoing involvement of Drs Andrew Mitchell and Murray Fletcher, respectively, of NSW Department of Primary Industries.

The first objective of this project is to develop a comprehensive biological understanding of the causes of FD. In pursuit of this, bibliographic information on FD and Z. lobulata as well as similar disorders and pests has been sourced from various scientific databases and an electronic library has been compiled using a proprietary bibliographic software package. Copies of all relevant publications have been collected and complemented by a significant volume of personal communication material that has been obtained from liaison with palm health researchers around the world. All of this information has been synthesised into a comprehensive review article that will be submitted for publication in a scientific journal.

The identity of Z. lobulata has been confirmed by comparing specimens collected from a range of locations in West New Britain with the formal taxonomic description for specimens from various parts of mainland PNG. This project has employed morphological characters, particularly male genitalia, and molecular methods using the CO1 gene. Results indicated consistency of all morphological and molecular characters and there was no evidence found for additional or cryptic species.

Screening of Z. lobulata and palm material for possible microbial pathogens is well advanced and a series of large insect-proof cages has been constructed to establish an experiment to elucidate the role of Z. lobulata and its relationship with FD. Laboratory studies have shown that planthoppers will feed on a 5% sucrose solution presented through a semipermeable membrane. This will enable samples of saliva to be collected from individual planthoppers for DNA testing for the presence of potential pathogens.

Field work aiming to identify natural enemies of Z. lobulata that could be used as biological control agents resulted in the collection of several taxa of parasitic wasps belonging to the family Mymaridae and a currently undetermined genus. These were common parasitoids of Z. lobulata egg masses on West New Britain. Samples of the Myrmaridae have been sent to Canada for identification and formal description (they are likely to be new species). Samples of Z. lobulata that had been killed by insect diseases especially fungus have been collected from various sites in West New Britain and preserved material delivered to Australia. Preliminary identifications suggest most are a species of Sporothrix whilst others are from Gliomatix or similar genus. Further taxonomic and pathogenicity studies are planned.

Monthly monitoring of Z. lobulata numbers and FD symptoms on betel nut, oil and coconut palm has been running since January 2008 on a small holder oil palm block in West New Britain.

Work on the second objective of the project - to develop preliminary control methods for FD is at an early stage because it is contingent on the findings of the first objective.

Yellow sticky traps have been evaluated in the field for monitoring adult Z. lobulata but proved to be ineffective. An experiment comparing a range of alternative trap colours is in progress.

Laboratory experiments have taken place to evaluate the influence of nectar rich ground cover plants on the lifespan of the mymarids. Results showed that adults lived longer with access to the flowers compared with those that were fed on water alone. Further work will be conducted in June 2008 using a variety of different cover crops and additional species of natural enemies to identify the scope for these plants to be used as a management approach that attract and support biological control agents of Z. lobulata.

PC/2006/114: Managing cocoa pod borer in PNG through improved risk incursion management capabilities, IPM strategies and stakeholder participatory training

Summary

Smallholder livelihoods derived from cocoa in PNG are threatened by the incursion of the cocoa pod borer *Conopomorpha cramerella* into the country. The pest was first detected in the Kerevat area of East New Britain Province in March 2006 and later confirmed in Aitape of West Sepik Province in June. Eradication operations, implemented in East New Britain after the first detection, were not fully implemented at West Sepik, and cocoa pod borer re-emerged in the Vudal, Tais and Tokiala smallholder blocks in the Gazelle Peninsula in March 2007.

The project will assist PNG to effectively implement systematic and long-term pod borer management through enhancing stakeholder knowledge and awareness, strengthening surveillance and monitoring efforts, development of pragmatic resource-matched and location-specific integrated pest management programs, and development of farmer participatory training and research.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: CAB International, Southeast Asia Regional Centre, Malaysia

Project Leader

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Collaborating Institutions

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

Project Budget: $704,300

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

First progress report due in 2009.

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

Summary

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

Project information

Overseas Collaborating Countries: Indonesia, Papua New Guinea

Commissioned Organisation: CABI South East and East Asia, Malaysia

Project Leader

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Collaborating Institutions

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

Project Budget: $1,014,062

Project Duration: 01/06/2008 to 31/05/2013

ACIAR Research Program Manager: Dr Les Baxter

Project progress

First progress report due in 2009.

FIS/2005/096: Assessment of the impact of the PNG purse seine fishery on tuna stocks, with special focus on the impact of fish aggregation devices (FADs)

Summary

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

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Secretariat of the Pacific Community, Oceanic Fisheries Programme, New Caledonia

Project Leader

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Collaborating Institutions

- National Fisheries Authority, Papua New Guinea
- University of Hawaii, USA

Project Budget: $400,000

Project Duration: 01/05/2006 to 31/12/2009

ACIAR Research Program Manager: Mr Barney Smith

Project progress

Year 2 (01/06/2007-31/05/2008)

Tuna catches in PNG have averaged about 300,000 tonnes per year over the past five years, producing on average 20% of the total western and central Pacific purse-seine catch. Catch has been steadily increasing with time and in 2006 the catch exceeded 400,000 tonnes. The purse seine fishery in PNG is strongly dependent on floating objects, in particular anchored fish aggregation devices (FADs). Therefore, a significant proportion of the catch consists of juvenile yellowfin and bigeye tuna, which aggregate in large quantities around FADs. Recent regional stock assessments have raised concerns about the long-term viability of these stocks. Priorities for fisheries management in PNG are to better understand: the impacts of these large catches on local tuna stocks; and the impacts of FADs on the fishery, on the target species and on non-target species.

The overall goal of this project is to improve management of the tuna fishery in PNG by the collection of new information on tuna population dynamics and fishery impacts (including FADs). The specific objectives of the project are

- To obtain information on the dynamics of bigeye, yellowfin and skipjack stocks in PNG waters, including information on local exploitation rates.
- To obtain information on the dynamics of tuna associations with FADs, in particular species-specific information on residence times, vertical and horizontal movements and FAD interactions.
- To characterize the variability and extent of catches of non-target species from purse seine catches in PNG.
- Development of management advice and recommendations for the PNG tuna fishery.

The primary method applied by the project is the tag and release of the target tuna species (yellowfin, skipjack and bigeye) in PNG waters. Four periods of vessel charter, involving a commercial pole-and-line vessel were commissioned to achieve this objective. The Bismarck Sea, where a majority of FADs are deployed and where much of the PNG domestic catch originates from, was designated as the primary operational area.

During the charter periods (August-November 2006; February-May 2007, November 2007, February-April 2008),

102400 tunas were tagged and released over a wide area of the PNG EEZ and neighbouring sections of the Solomon Islands EEZ. The numbers of bigeye tagged were smaller than expected, due to the relatively low vulnerability and/or abundance of the species during the tagging period. 318 of the releases were archival tags and 222 sonic tags deployed in association with receivers attached to FAD arrays. 72 % of the releases were on anchored FADs, 17% on unassociated (free) schools and the remainder on a variety of other school types.

The analysis and modelling of tag returns with reliable information on date, place and method of capture will inform two of the main objectives of the project, with a recapture rate of close to 20%, spread over multiple years, anticipated. To ensure recaptured fish are returned with necessary information, publicity campaigns covering the main unloading, processing and transhipment points through the entire western and central Pacific Ocean (and in some cases beyond) are necessary, reinforced by rewards for the return of tags. Posters publicizing the project and the reward payments have been prepared in 13 languages and widely distributed. Contact persons have also been appointed in key locations to coordinate the recovery of tags.

As at the 30th of April 2008, 10431 tags, mostly with good information, had been returned to SPC, representing an overall recovery rate of 10.1%, in line with expectations of a final return rate of 20%. Recovery rates for yellowfin and bigeye tuna were slightly higher than those for skipjack, as a result of the often longer residence times around FADs resulting in increased vulnerability. 90% of the returns were of fish FAD-associated at release, with the majority of returns for all three species after 40 days at liberty. The average distance moved with time at liberty is increasing with time, as the tagged fish dispersed, after most initial recoveries were close to the point of release. As with previous experiments, skipjack appears to be more mobile then the other two species, with some recoveries already several thousand nm from the point of release.

PNG officers have been trained in all aspects of tuna tagging methods, biological sampling and preliminary data analysis, and have also participated with great success in the archival and sonic tagging. Analysis of PNG observer data, the only reliable source of information data on non-target species in the purse seine fishery, has commenced, well ahead of schedule, to address the third project objective, i.e. characterization of catches of non-target species. Development of management advice and recommendations will occur after the majority of the tagging data are available, and is programmed for mid-2009.

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

Summary

Forest resources are a major contributor to different sectors of the PNG economy. The log export industry alone contributed some Kina 200 million to the national economy in 2003, but its current level of harvesting is unsustainable and accessible primary forest is likely to be logged out in the next 15 years.

Properly managed, however, PNG's forest resources could continue to make a major, sustainable contribution to the PNG economy, while maintaining many of the qualities that PNG society values from its forests. ACIAR's forestry strategy for PNG, developed in collaboration with PNG colleagues, is designed to promote a positive vision for PNG forestry. This project, a key element of the strategy, aims to improve the contribution that PNG's secondary forests make to national and local economies by developing appropriate strategies for their management and marketing. Project outputs will complement broader work on marketing of PNG timber, under consideration by the International Tropical Timber Organisation (ITTO) and others.

Specific objectives are to:

- classify PNG's secondary forests in terms of condition and capacity for future growth and to produce timber and other products and services
- assess the future market opportunities for different products and develop effective methods for linking local producers with purchasers of sustainably produced timber
- analyse options for future supply in collaboration with forest owners, based on supply of different products and taking into account their community and external market values, and to design appropriate management and marketing strategies
- train community-based NGO staff in forest assessment and analysis of different forest management options that will allow local forest owners to obtain future sources of revenue from their forests.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Melbourne, School of Forest and Ecosystem Science, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $783,318

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

ACIAR Research Program Manager: Dr Russell Haines

Project progress

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

Progress on the project has been excellent thanks to strong working relationships with PNG partner organisations; PNG Forest Research Institute (FRI) and Village Development Trust (VDT). Project scientists spent March in PNG collaborating with FRI and VDT, and a project workshop was conducted on the 13th and 14th March with 23 stakeholders involved in the management of, or deriving livelihoods from, cutover native forests in PNG. Several important outcomes flowed from the workshop; the neglect and ongoing degradation of cutover forest is largely due to poor knowledge of the goods and services that may be available; assessment of this resource is a priority and the goods and services (such as timber, carbon and biodiversity benefits) that are available need to be communicated to communities to ensure they make informed decisions, derive benefit from their resource, and to avoid further degradation.

Group exercises with stakeholders identified several priorities for future project work that would have the greatest impact on community livelihoods; forest assessment methods used by forest certification bodies are labour intensive,

inefficient, and possibly biased; this could be ameliorated using a random cluster sampling approach; there are definite market prospects for minor timber species (that dominate cutover forest) when sold as certified product that could provide community revenue; cutover forest needs to be classified according to the products it may provide now and into the future and forest assessment using remote sensing and forest growth modelling based on Permanent Sample Plot (PSP) information is an obvious way forward.

To enable forest assessment work to proceed, project scientists spent time at FRI in Lae cleaning and collating PSP data collected between 1992 and 2008 into an Access database, thus improving the capacity to analyse and report on growth in cutover forest. Based on PSPs, growth model development is underway, and models are being developed for sustainability and scenario analysis at two scales of forest utilisation in PNG; stand models for large-scale utilisation at the forest concession scale and individual-tree models for small-scale utilisation at the community level. The tropical forests of PNG are structurally complex and highly diverse both in structure and the species they contain. Because individual trees in PSPs are spatially mapped, work is underway trying to extricate the spatial competitive processes governing tree growth. Understanding these processes in these rarely studied forests has high scientific currency, and several high impact publications are in preparation. Beyond scientific currency, models will facilitate accurate growth and yield modelling that can inform small-scale community level utilisation.

In consultation with project partner VDT areas for initial assessment work have been identified; the small to medium sized community operations of Sogi in Madang Province, and Yalu and Gabensis in the Morobe province. Baseline community information has been collected, and a suite of remotely sensed optical (LANDSAT 5, LANDSAT 7 ETM, and ASTER) and radar (JERS-1) data over the study areas has been acquired. The Forest Canopy Density Mapper (FCD) has been applied to optical data to classify cutover forest according to canopy density. Analysis of JERS-1 radar data has revealed that forest canopy backscatter is related to tree volume on PSPs. This work is ongoing, but preliminary work in the pilot region indicates the potential for a rapid and cost effective assessment method for cutover forest in PNG.

Forest certification bodies operating in PNG have been engaged, and project scientists participated in a 2 day workshop on forest certification held in Port Moresby on 11th and 12th of March. The benefits of certification in empowering landowners, improving livelihoods, preserving the natural environment, and facilitating sustainable development were demonstrated, and it is a priority that the forest assessment activities underway in this project inform and improve forest certification efforts in PNG.

5 Projects expected to start in 2008–09

Project number	Project title
AH/2008/037	Bee parasites/Varroa mite - PNG
ASEM/2008/033	An assessment of the Oribius weevil outbreak in Papua New Guinea and its impact on coffee yield and productivity in Simbu and adjacent provinces
ASEM/2008/034	Socio-economic impact assessment of cocoa pod borer in East New Britain province, Papua New Guinea
ASEM/2008/035	Coffee PNG scoping study - PNG
PC/2007/039	The control of basal stem rot of oil palm caused by Ganoderma in Solomon Islands
PLIA/2005/149	A comparison of policy environments for cocoa technology adoption and industry development in Bougainville and other parts of PNG
PLIA/2006/004	Road improvement in PNG and implications for adoption of research outcomes for coffee growers
SMCN/2008/028	Towards sustainable oil palm industry in PNG
SMCN/2008/032	Horticulture PNG Scoping study

6 Papua New Guinea chapter from the Annual Report 2007–08

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

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.
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.

6.1 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.

6.2 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 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.

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 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 trails 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.

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 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.

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 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.

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.

6.3 Projects concluded in 2007–08

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

Summary

Zoonotic diseases (diseases transmitted from animals to humans) are thought to be increasing in the South Pacific as livestock production intensifies. Most countries and territories are experiencing a growing demand for animal products, as human populations increase and expectations rise for higher living standards. Greater intensification of animal production in areas with limited land resources has increased the possibility of human–animal contact, and thus the risk of zoonotic disease. Trichinellosis, leptospirosis and angiostrongylosis are the diseases of most concern in the region. Leptospirosis infection causes production loss in livestock and is a serious public health issue, especially for owners of livestock and workers in the processing industry. *Angiostrongylus cantonensis* infection is an unquantified threat to livestock health and is emerging as a serious problem. *Trichinella* infection in pigs is a barrier to trade and could result in significant loss to producers. If this organism entered Australia, it could cause severe economic losses to the Australian pork industry.

Project information

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

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

Project Leader

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Collaborating Institutions

- National Agriculture Quarantine and Inspection Authority, Papua New Guinea
- Secretariat of the Pacific Community, Fiji
- University of Melbourne, Australia
- Children's Hospital, Westmead, Australia
- Department of Agriculture, Fisheries and Forestry, Australia
- WHO/FAO/OIE Collaborating Centre for Reference & Research on Leptospirosis, Australia

Project Budget: $555,579

Project Duration: 01/01/2002 - 31/12/2007

ACIAR Research Program Manager: Dr Doug Gray

Project outcomes

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

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

The major benefits to be gained from this project are in improvements to the productivity of beef cattle through the development and application of control programs for leptospirosis. This should lead to increased incomes for smallholders as they access an increasing market for their cattle. Knowledge of the public health significance of zoonotic infections is important because it provides information that can be used to prioritise scarce resources.

ASEM/2001/016: Microbial contaminants associated with sago processing and storage in Papua New Guinea

Summary

Sago harvesting and consumption form an important part of the staple diet in selected areas of Papua New Guinea (PNG). However, this resource (in excess of 1 million hectares) is under-utilised. There is an estimated market for sago starch in PNG in excess of 12,000 tonnes (some of which is presently imported), and part of the international trade in starch, (15,000-20,000 tonnes into Australia alone) at $A150-200 per tonne could be filled by PNG sago. However the ability to satisfy these markets with high quality starch, essentially free of mycotoxins and food borne pathogens is not assured.

Contaminant problems relate to the presence of mycotoxins in the starch, which may lead to sago haemolytic disease. This is prevalent in the main sago growing areas in the south of the country; however, its cause has never been resolved. Contamination of food with pathogenic bacteria and viruses is likely to be of a widespread nature, since the incidence of diarrhoeal disease is extensive and caused by some of the bacterial agents associated with sago contamination (determined by experimental sampling from selected market sites). The extent and seriousness of sago contamination cannot be fully understood until a more extensive investigation is mounted. Both the definition of contamination problems (fungal and bacterial) and the development of suitable solutions are of equal importance to the development of PNG sago as a village food and as a trade commodity.

This project determined the causes and extent of health risks to consumers caused by contamination in village-produced sago in Papua New Guinea, to identify options for reducing those risks and improving marketability of the processed sago.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: James Cook University, Australia

Project Leader

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Collaborating Institutions

- Queensland Department of Primary Industries and Fisheries, Animal Research Institute, Australia
- University of Technology, Department of Applied Sciences, Papua New Guinea
- University of Papua New Guinea, School of Humanities and Social Sciences, Papua New Guinea

Project Budget: $549,858

Project Duration: 01/07/2002 to 31/12/2007 (Project extended from 01/01/2005 to 31/12/2007)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project outcomes

The project collected data on the techniques in use in two regions of PNG (Sepik and Western Provinces) for the production of sago starch, identified potential bacterial agents of foodborne illness associated with these products, and assessed the degree of fungal contamination and potential for mycotoxin production in these products – to attempt to elucidate the causative agent/compound responsible for sago haemolytic disease, and to train PNG scientists in the culture of foodborne pathogens and fungi using Australian Standard Methods for the detection of mycotoxins. These data will be used to inform production processes for sago starch and to develop recommendations for reducing sago health risks, leading to improvements in the health of consumers and the development of an export industry.

Tandem studies of storage method and contaminants together with the HACCP analyses indicated that fermentation and storage of sago in palm leaf bundles (in Western province) and clay pots (in East Sepik) produced product of 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.

Other outcomes included:

- The project identified a potential novel compound from a fungal isolate derived from sago starch that shows strong haemolytic activity with human red blood cells.
- A simple process using washed red blood cells was developed to assay novel compounds derived from fungal cultures following extraction for haemolytic activity.
- PNG scientists were trained in the formal culture and identification of a range of bacteria and fungi of public health significance, as well as the analysis of foods for mycotoxins.

Further work is now needed to characterise the novel compound isolated, demonstrate that Koch's postulates can be verified with this compound, and complete the analysis of other fungal isolates for novel compounds with haemolytic capability.

The project team also organised a symposium in Port Moresby during September 2005 that involved team members, health workers, provincial and national government representatives, the Governor of Western province and the member for Middle Fly to report project findings and those of complementary medical research and propose recommendations for reducing sago health risks.

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

Summary

Earlier ACIAR-funded research had promoted interventions in the smallholder oil palm sector of Papua New Guinea (PNG), including the increased participation of women in the industry through the 'lus frut mama' card scheme that led to significant increases in smallholder productivity. This project aimed to replicate such achievements in the PNG smallholder cocoa and coconut sectors. Researchers conducted an in-depth evaluation of a promising new payment system (also arising from the earlier ACIAR project) for oil palm smallholders at Hoskins, West New Britain and sought to further adapt it for other smallholder oil palm regions and for the smallholder cocoa sector in PNG. The project was designed to promote the sharing of knowledge and expertise between the key smallholder extension agencies and research organisations in the three industries.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: Curtin University of Technology, Australia

Project Leader

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Collaborating Institutions

- Cocoa and Coconut Research Institute, Papua New Guinea
- Oil Palm Research Association, Papua New Guinea
- PNG Cocoa & Coconut Extension Agency, Papua New Guinea

Project Budget: $647,736

Project Duration: 01/07/2003 to 31/12/2007 (Project extended from 01/07/2006 to 31/12/2007)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project outcomes

Key constraints on smallholder productivity were labour shortages in both crops and poor block maintenance, especially in cocoa; the non-payment or under-payment of family and hired labour was a key factor limiting the supply of labour. In oil palm this had been addressed through the 'Mobile Card' trial at Hoskins (ASEM/1999/084) which involved paying family and hired labour a portion of the harvested fruit and thereby circumventing the problem of payment uncertainty associated with cash payments for labour. That trial was evaluated as part of this project, and a second payment trial that ran for 23 months to December 2007 was undertaken amongst Bialla growers.

By guaranteeing payment of labour, disincentives to the mobilisation of family and hired labour were reduced. At Hoskins, monthly production rose from 75% of the smallholder average to 113% during months when Mobile Card labour was deployed. Productivity and incomes rose on 90% of trial blocks with 30% improving by more than 50 percentage points. Similar results were obtained in the Bialla trial.

It was found that the age of a cocoa stand is a determinant of its condition – including vegetation structure, degree of shading and pest and disease levels. With little or no pruning and shade control, and virtually no management of pests and diseases, block condition is largely a function of its age. Until about 7 or 8 years of age there is some grass slashing and harvesting groups tend to be relatively large, comprising both men and women following a dry cocoa bean production strategy. Beyond this age, pest and disease levels are high and accessibility for harvesting declines. Growers switch from a 'farming' to a 'foraging' production strategy, consisting of very low labour inputs (mainly women) making brief harvesting forays to collect small quantities of crop for sale as wet bean to pay for immediate consumption needs.

The project began working with the commercial sector to deliver extension and farm inputs funded by deductions from growers' payments. A follow-on project, ASEM/2006/127, is extending this to include a Mobile Card payment mechanism to mobilise smallholder labour for cocoa maintenance tasks and to address the cocoa pod borer (CPB) problem.

ASEM/2006/068: Analytical equipment in support of the ACIAR/Unitech Postgraduate Scholarship Scheme

Summary

The ACIAR Postgraduate Scholarship Scheme for UNITECH was initiated in March 2005. Eighteen annual scholarships will be awarded to 12-15 students between 2005 and 2008 for research in a wide range of topics - crop physiology and agronomy of sweet potato, taro, peanut and cocoa, plant pathology, entomology, fish and poultry nutrition, animal health, agricultural engineering and extension - with most continuing on from Postgraduate Diploma to Masters of Philosophy. This small project activity will enable the purchase of a LECO carbon and nitrogen analyser (to measure these two important elements) and other equipment to give a laboratory at Unitech comprehensive capability for the analysis of macro- and micro-elements in plant, animal, soil and water samples.

Project information

Overseas Collaborating Countries: Papua New Guinea

Commissioned Organisation: University of Queensland, School of Animal Studies, Australia

Project Leader

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Collaborating Institutions

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

Project Budget: $149,930

Project Duration: 01/10/2006 to 31/03/2008 (Project extended from 01/07/2007 to 31/03/2008)

ACIAR Research Program Manager: Dr Ken Menz

Project outcomes

Final report not yet submitted by the project leader.

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

Summary

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

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

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

Project information

Overseas Collaborating Countries: Fiji, Papua New Guinea

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader

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Collaborating Institutions

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

Project Budget: $853,855

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

ACIAR Research Program Manager: Dr T K Lim

Project outcomes

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

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

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

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

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

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

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

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

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

Summary

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

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

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

Project information

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

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

Project Leader

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Collaborating Institutions

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

Project Budget: $577,584

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

ACIAR Research Program Manager: Mr Barney Smith

Project outcomes

Final report not yet submitted by the project leader.

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

Summary

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

Project information

Overseas Collaborating Countries: Fiji, Papua New Guinea

Commissioned Organisation: Secretariat of the Pacific Community, Fiji

Project Leader

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Collaborating Institutions

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

Project Budget: $96,300

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

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

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

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

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

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

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

Fiji:

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

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

PNG:

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

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

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

SMCN/2006/031: Analysis of nutritional constraints to cocoa production in PNG

Summary

Cocoa is a primary cash crop in many coastal areas of PNG, bringing in export earnings of around K200 million annually. But yields fall far below the theoretical productive potential for dry beans of 11 tonnes per hectare per year. Higher yielding hybrids are planted in some areas, but typically decline after reaching maximum production five to seven years after planting, and this seems strongly linked to nutritional problems. The objective of this one-year study was to provide the information necessary to appropriately design and correctly target future RD&E investments into soil fertility and crop nutrition management in cocoa production systems of PNG.

Project information

Overseas Collaborating Countries: Papua New Guinea

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

Project Leader

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Collaborating Institutions

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- Cocoa Coconut Institute of Papua New Guinea, Cocoa Research Division, Papua New Guinea
- Curtin University of Technology, School of Social Sciences, Australia

Project Budget: $100,316

Project Duration: 01/04/2007 to 30/04/2008 (Project extended from 01/12/2007 to 30/04/2008)

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project outcomes

A survey was carried out in which 63 sites across the country were assessed and sampled for soil and tissue analysis. The sites were on smallholder blocks (48), plantations (6) and CCI trials (9).Based on leaf analyses, nitrogen (N) and iron (Fe) deficiencies appear to be very widespread, with 95% of sampled blocks falling below the critical level for N and 89% for Fe. Phosphorus (P) deficiencies were encountered in about a quarter of the blocks sampled. Leaf magnesium (Mg) concentrations were adequate in most blocks in most provinces, except for East New Britain Province, where 64% of the blocks sampled were deficient.

Deficiencies of potassium (K), calcium (Ca), manganese (Mn), boron (B), copper (Cu) and zinc (Zn) were encountered in 2–15% of sampled blocks. If the widespread N deficiencies were to be overcome it could be expected that the extent and severity of other nutrient deficiencies would increase substantially. There were significant relationships between leaf K, Ca and P concentrations and soil K, Ca and P contents. There was also a significant correlation between leaf Mg concentration and the ratio of soil exchangeable Mg:K. Growers who had used fertiliser (approximately one third of those surveyed) generally reported positive responses in growth, flowering and pod production.

The research team concluded that in blocks well maintained and regularly harvested it was quite likely that nutrient deficiencies were constraining. It was generally agreed that management of cocoa blocks in PNG must improve dramatically for the cocoa industry to prosper – perhaps even to survive – with the likely spread of cocoa pod borer. Widespread replanting is also necessary. If these improvements occur, then it is likely that limitations due to nutrient deficiencies will become more important.

Although only a one-year scoping study, this project had a number of impacts. It substantially increased the awareness of soil fertility and cocoa nutrition issues in the cocoa-growing community – such as smallholders, plantation managers, and researchers. It also raised awareness among other groups such as the Cocoa Board. In addition, it produced the most comprehensive, representative and well-documented survey of nutrient status in plant tissue and soil ever conducted in PNG.

Project recommendations fell into four main categories:

1. research to improve understanding of nutrition-related limitations to production
2. production of nutrient management recommendations appropriate to different regions
3. establishment of effective pathways to adoption
4. education and capacity-building to ensure continued improvements in nutrient management research and extension.

7 Impact assessment program

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

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

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

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

7.1 Impact assessments undertaken in 2007-08

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

We have continued to focus on quantification of capacity building impacts. The study on pig improvement in Vietnam specifically focused on this and continued to demonstrate that this is an important aspect of ACIAR's partnership modality. Two dimensions were again identified. The first is the contribution the capacity building makes to enhancing the impact of the technology specifically developed by the research. The second is the longer term impact the enhanced capacity has on future activities and investments; this was again shown to be a significant source of welfare gains from the R&D. Several other studies considered the capacity building impacts but it was found that if the elapsed time since completion of the project had not been long enough, it was too early to reliably identify the subsequent impacts.

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

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

The impact of increasing efficiency and productivity of ruminants in

India by use of protected-nutrient technology

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

ACIAR fisheries projects in Indonesia: review and impact assessment

This study provides a review of all ACIAR-funded fisheries research in Indonesia and two detailed impact assessment studies – tuna capture fisheries and shrimp aquaculture. For captured fisheries management, the assessment shows that the capacity developed in early projects contributed significantly to Indonesia becoming a member of a regional fisheries management group and to the associated access to high value markets for southern blue fin tuna caught in Indonesian waters. The estimated net present value of the welfare gains from the investments required to achieve Indonesian membership of this regional group is $1,100 million. The share of these returns attributable to the ACIAR supported component is assessed to be $168 million, indicating a return on ACIAR- and partner-invested funds of a benefit to cost ratio of 179:1 and an internal rate of return of 210 per cent.

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

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

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

7.2 Planned impact assessments in 2008–09

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

Project-specific

Publish five assessments of the impacts of completed projects in 2008–09.

Measurement of economic growth, environmental, social and capacity-building impacts will be incorporated where identified as important and possible. This year we will continue the process of selecting some projects for assessment using a stratified sampling process. The stratification of projects will be based on a range of considerations such as program area, geographic location, types of research and sector of the economy.

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

Capacity building

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

Develop collaboration with international CG centres in impact assessment activities, particularly of projects jointly funded through ACIAR.

Provide feedback on the implications of impact assessment studies for research project development and management within ACIAR, through 'lessons learnt' style meetings with all staff.

Enhance the clarification and estimation of the outcomes of new projects, by assisting project research groups during peer review of their proposals and by including impact analysis in the project design. In particular, summaries of the implications of impact studies will be provided to meetings of these groups.

Thematic studies

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

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

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

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

8 Appendix 1: ACIAR Contacts

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9 Appendix 2: ACIAR Publications

This is a list of ACIAR publications produced in 2007–08. Print copies are available by emailing <comms@aciar.gov.au>, or electronic versions may be downloaded from ACIAR's website <www.aciar.gov.au>.

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

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

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

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

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

Final Reports	
2007-01 [AH/2006/164]	*Future directions for animal health services in Indonesia.* Helen Scott-Orr, Bruce Christie and Tristan Jubb, 2007, 29 pp. http://www.aciar.gov.au/node/3508
2007-02 [FST/2005/049]	*Mastotermes darwiniensis in the Lae area of PNG.* B.M. Thistleton, M. Neal, M. Peki and J. Dobunaba, 2007, 50 pp. http://www.aciar.gov.au/node/3945
2007-03 [SMAR/2007/229]	*Options for teak industry development in South East Sulawesi, Indonesia.* S. Midgley, A. Rimbawanto, Mahfudz, A. Fuazi and A. Brown, 2007, 41 pp. http://www.aciar.gov.au/node/3870
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