

**ACIAR COUNTRY PROFILES 2008–09:
PHILIPPINES**



ACIAR

Research that works for developing
countries and Australia

www.aciar.gov.au

2008

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1 Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of 18 projects that are active in 2008-09. There are another 3 projects under development, which are expected to start in 2008-09 financial year.

This publication also sets out the key outputs and outcomes from 5 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 Philippines chapter from the Annual Operational Plan 2008-09 and the 2007-08 Annual Report.

ACIAR updates this profile each year and distributes it to key stakeholders in the Philippines 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 2007

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 the Philippines

ACIAR has supported a program of collaborative agricultural research with the Philippines 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 the Philippines. The Philippines is also targeted in ACIAR's multilateral program delivered in conjunction with the international agricultural research centres.

As at June 2008, ACIAR's program in the Philippines comprised the following projects:

Bilateral program

Active projects	15 with a value over their lifetime of approximately \$14.746 million
Projects under development	1
Completed projects	127

Multilateral program

Active projects	3 with a value over their lifetime of approximately \$3.437 million
Projects under development	1
Completed projects	16

Total project budget 2008–09	\$3.97 million which represents 9.8% of the total project budget 2008–09
-------------------------------------	--

The research program in the Philippines is focused on southern Philippines—northern and southern Mindanao and Visayas, looking at the following agricultural priorities:

- Increase in market competitiveness of agricultural products with reference to meeting market specifications (focus on fruit, vegetable and aquaculture products)
- Farmer-based land and water resource management for profitable and sustainable agriculture
- Addressing of regulatory, policy, technical and social constraints to the adoption of research outputs.

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

Philippines Subprograms

Subprogram 1: Increasing the market competitiveness of Philippines agricultural products

Subprogram 2: Farmer-based land and water resource management for profitable and sustainable agriculture

Subprogram 3: Addressing regulatory, policy and technical constraints to the adoption of research outputs

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 the Philippines

		PhD	MSc/Other
Active	Male	4	1
	Female	3	1
Concluded	Male	3	5
	Female	10	4

Returnee Small Project Awards Scheme

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

John Dillon Memorial Fellowship

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

Short courses and workshops

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

On-the-job training

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

2.4 Policy Advisory Council member

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

The current member from the Philippines is Dr Patricio Faylon, Executive Director, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). Dr Faylon has been a member of the Council since March 2003.

Dr Arsenio Balisacan, Director, Southeast Asian Regional Centre for Graduate Study and Research in Agriculture, in the Philippines is also a member of the Council. Dr Balisacan represents South-East Asia.

3 Philippines chapter from the Annual Operational Plan 2008–09

GDP per capita (PPP ^a US\$)	5,137	Bilateral actual 2006–07	\$2.8 m
Population (millions)	85	Bilateral estimate 2007–08	\$3.3 m
Projected population (millions) 2015	101	Bilateral budget 2008–09	\$3.5 m
Active bilateral projects	18	Bilateral + multilateral budget 2008–09	\$4.0 m
Active multilateral projects	2		

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

3.1 Medium-term strategy

The main aim of ACIAR cooperation is to assist the Philippines to increase productivity, marketability and international competitiveness for its agricultural products, taking into account the impacts of trade liberalisation. Underlying this competitiveness is the need to improve agricultural productivity through more effective extension of research results and more responsiveness to market opportunities. This should result in higher quality commodities produced more competitively. Specific opportunities may come through research for development and marketing of products from aquaculture, horticulture, forestry and livestock enterprises and farmer-driven improvements in agricultural systems.

A significant proportion of Philippines farming is carried out in fragile sloping environments or sensitive watersheds, and it is important that intensification of agricultural productivity does not come at the expense of degradation. Efficient use of water will assume increased importance. To increase the prospects for

sustainable adoption of the results of research, ACIAR's Philippines program will increasingly emphasise involvement of local partners (such as local government units, NGOs and farmer community groups) in projects and commercial and agribusiness companies. It will also promote projects that implement the results of earlier ACIAR-supported research in the Philippines. As well, there will be a focus on fostering linkages between regionally based delivery organisations and research organisations and policymakers based centrally in Manila and Los Baños.

There is greater emphasis on the southern Philippines, within a limited number of focal provinces in regions 10 and 11 (Mindanao) and regions 6, 7 and 8 (Visayas). The southern Philippines has the greatest development needs and the strongest engagement of Australian interests across the whole of government.

3.2 Key performance indicators (2008–09)

- two major new horticultural programs that address major constraints in horticultural value chains in the southern Philippines under way
- successful adoption by farmers of better herbicide use strategies and weed management options in direct seeded rice
- community adoption of a multi-stakeholder approach to optimising soil and water resource sustainability and farmer incomes in southern and northern Luzon
- institutionalisation of the national landcare program through a Philippines-led organisation
- improvement in tree seedling supply resulting from economic and policy changes in the Philippines nursery sector in at least two provinces of the southern Philippines

3.3 Position

ACIAR's program in the Philippines has been active since 1983. Initially the program had several projects dedicated to research on soil management issues: nutrient management, erosion control, rice cropping systems, biological nitrogen fixation and tree establishment on degraded land. Research on postharvest storage of grain and giant clam culture was also important. During the 1990s research cooperation moved towards livestock management and biotechnology. A shift to emphasise the poorer areas of Mindanao and the Visayas, while maintaining strong links to research and development expertise in Manila and Los Baños, will continue.

Improving uptake of research in the Philippines is a major priority. In collaboration with Philippine partners, ACIAR has increased its emphasis on better understanding extension processes and involving farmer and community groups in projects. There has been encouraging success with the adaptation of the landcare approach in Mindanao, management of catchments in the Visayas island of Bohol, and uptake of methods for successful tree establishment. New research projects are underpinned by design processes that involve the end users of the research and address their needs. Project design also accommodates additional challenges that have arisen from the devolution of management and governance of extension responsibilities to local government units, and the comparatively weak research–extension linkages that frequently exist.

Two major horticultural initiatives were designed involving researchers, government, NGOs and industry partners, commencing in 2007–08 with an investment from ACIAR of approximately \$7 m. Both initiatives focus on the southern Philippines, specifically regions 8 (Leyte), 10 (northern Mindanao/Cagayan de Oro), and 11 (southern Mindanao/Davao). These are described below. Taken together, the initiatives address most of the agreed priorities in subprograms 1A, 1B and 1C. It is not anticipated that additional funding for horticultural projects will be available during 2008–09.

During 2006 a new initiative, the Community Agricultural Technology Program, commenced which aimed to link ACIAR-generated technologies and Philippines research providers with non-government and community-based organisations. This is ongoing in 2008–09.

One major international agricultural research organisation, the International Rice Research Institute (IRRI), is headquartered in Los Baños, Philippines. ACIAR provides core funding to IRRI and also supports additional initiatives aimed at maintaining rice productivity. The regional office of the International Network for the Improvement of Banana and Plantain (INIBAP), a bioersity network, is also headquartered in the Philippines.

3.4 Relationship to the Australia-Philippines Development Assistance Strategy 2007-11

Australia's objective under the new Australia–Philippines Development Assistance Strategy (2007–2011) is to 'make a contribution to improving the prospects for economic growth, poverty reduction and national stability in the Philippines'. The strategy will focus on three pillars: economic growth, basic education, and national stability and human security.

ACIAR will contribute to the strategy particularly through the first (and largest) pillar, which includes engagement with the Philippine Government on policy issues and support for

'local economic development in poor areas so that the rural population shares in the benefits of a stronger national economy'. Linkages between the biophysical, economic and market development research support by ACIAR will be made with the new AusAID Rural and Private Sector Development Program, as well as between ACIAR projects and the AusAID-funded Philippines–Australia Community Assistance Program.

3.5 Research priorities

ACIAR has a program of consultations with key partner countries on a 4-year rolling basis to establish priorities for research collaboration. The most recent full program consultation with the Philippines was held in March 2006; a record of the consultation is available at <www.aciar.gov.au> under Partner country priorities / Philippines. A horticulture consultation workshop was held in September 2007.

Most ACIAR-supported informal and postgraduate research degree training will remain within the context of active projects. However, ACIAR will also support short training courses that strengthen capacity to apply results of research to fit the needs of farmers and policymakers. The program of training will comprise the following courses: economics and social science for biophysical scientists; participatory agricultural research/extension; project evaluation and impact assessment; research business management and commercialisation; information and communication technology for R&D; and training in supply chain management.

Agreed priorities for collaborative research and development programs are listed under three thematic areas.

Subprogram 1: Increasing the market competitiveness of Philippines agricultural products

1A: Meeting market specifications for horticultural products

- Identification of farmer incentives for adoption of horticultural postharvest systems improvements
- Development and implementation of new quality management and food safety standards and systems
- Economic analysis of marketing chains and channels for perishables
- Building of supply chains: improvement in alliances between suppliers, processors, institutional buyers and marketers
- Nutrient and pesticide management to save costs and reduce residues

1B: Higher returns from horticulture products

- Adoption of protected cropping technologies and reduction of inputs

- Disease management: bacterial wilt and other soil-borne diseases in solanaceous and crucifer crops; efficient production systems for seed potato
- Pest management: systems for diamondback moth management in brassicas
- Germplasm collection and evaluation and development of cultural packages and native vegetables
- Improvement in postharvest handling: shelf-life extension, product development, packaging, quality and sanitary and phytosanitary standards (SPSS) for markets for salad and semi-temperate vegetables
- Tropical fruit for export and premium domestic markets
- Selection and clonal propagation of new quality mango germplasm
- Control of major pests and diseases of mango
- Improvement in postharvest handling: cultural practices, shelf life extension, product development, packaging, quality and SPSS for markets for jackfruit, mango and new tropical fruit crops
- Control of major pests and diseases in durian and jackfruit

1C: Competitive and sustainable aquaculture production

- Adoption of mariculture-based strategies to provide livelihoods and enhance locally managed fisheries with an initial emphasis on sea cucumbers
- Assessment of the impacts of mariculture on community livelihoods of small fishers
- Review of opportunities and constraints in the supply chain for key aquaculture products, particularly grouper and mud crab
- Management of viral nervous necrosis of marine finfish
- Integrated use and management of on-farm ponds and small water impoundments for freshwater fish production

- Application in the Philippines of results from ACIAR aquaculture projects in other countries

Subprogram 2: Farmer-based land and water resource management for profitable and sustainable agriculture

- Catchment-scale adaptation of landcare-type activities for integrated soil and water conservation, agricultural production and enhanced market focus
- Water resource management (including groundwater and water harvesting) for high-value vegetable and fruit crops
- Implementation of valuation and financing mechanisms for environmental services in watersheds for soil and water conservation
- Integrated nutrient management for low-input farming systems
- Utilisation of urban waste and treated wastewater for peri-urban agriculture
- Market identification and use of industrial trees and fast-growing agroforestry species
- Introduction of propagation systems for indigenous trees for soil and water conservation

Subprogram 3: Addressing regulatory, policy and technical constraints to the adoption of research outputs

- Development of simple replicable financial/business models for agribusiness development of small farms
- Application of better extension models for packaging earlier research results (e.g. on livestock production and health, horticulture, aquaculture and agroforestry)
- Identification and addressing of local and national policy constraints to adoption of research, including:
 - land use, land tenure, taxation and transportation
 - policies
 - sanitary and phytosanitary standards
 - intellectual property rights

- Assessment of policy constraints to agroforestry development on small farms
- Assessment of policy constraints to the control and management of illegal, unregulated and unreported (IUU) fishing

4 Active projects in the Philippines

4.1 Subprogram 1: Increasing the market competitiveness of Philippines agricultural products

1A: Better systems and policies for meeting market specifications

Projects:

Project number	Project title	Page
ASEM/2003/009	Bridging the gap between seasonal climate forecasts and decision makers in agriculture	14
CIM/2002/106	Fertilisation independent formation of embryo, endosperm and pericarp for apomictic hybrid rice	16
CIM/2006/176 (multilateral)	Developing molecular markers to enable selection against chalk in rice (IRRI)	17

1B: Higher returns from horticultural products

In 2007–08 two major multidisciplinary horticultural initiatives—involving four ACIAR programs, researchers, government, NGOs and industry partners—were developed and commissioned. The first initiative, ‘Enhanced profitability of selected vegetable value chains in the southern Philippines’ (HORT/2007/066), aims to improve smallholder and industry profitability and market competitiveness of selected vegetable industries (including potato, tomato, bell pepper, brassicas, leafy vegetables) in the southern Philippines. It includes technical interventions such as improved use of composts and nutrients in production systems, development of more profitable off-season production (particularly protected cropping) of high-value vegetables, management of major pests, and identification and management of diseases of solanaceous and brassica vegetables. In addition, priorities and constraints in key value chains will be identified and analysed, and appropriate interventions developed, tested and implemented, to strengthen linkages between smallholders, the private sector and markets. The second initiative, ‘Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines’ (HORT/2007/067), covers mango, papaya, durian and jackfruit. It aims to identify and implement improvements to domestic and export value chains for these fruits through targeted interventions in policy and regulatory analysis, production, disease and pest management, and postharvest handling.

Projects:

Project number	Project title	Page
HORT/2001/049	Development of PRSP–V resistant papaya genotypes by introgression of genes from wild <i>Carica</i> species	19
HORT/2003/071	Integrated pest management and supply chain improvement for mangoes in the Philippines and Australia	21
HORT/2007/066	Enhanced profitability of selected vegetable value chains in the southern Philippines	22
HORT/2007/067	Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines	24

1C: Competitive and sustainable aquaculture production

Projects:

Project number	Project title	Page
FIS/2002/077	Improved hatchery and grow-out technology for marine finfish in the Asia–Pacific region	26
FIS/2003/033	Integrated fisheries resource management (Rinconada Lakes, the Philippines, and New South Wales, Australia)	28
FIS/2003/059 (multilateral)	Sea ranching and restocking sandfish (<i>Holothuria scabra</i>) in Asia–Pacific (WorldFish)	30
FIS/2007/045	Evaluation of production technology, product quality and market potential for the development of bivalve mollusc aquaculture in the Philippines	32

ASEM/2003/009: Bridging the gap between seasonal climate forecasts and decision makers in agriculture

Summary

Climate variability is particularly problematic in rainfed agricultural systems, such as those found in the Philippines and eastern Australia. One main cause of variability in both countries is the El Niño Southern Oscillation (ENSO). The ENSO phenomenon causes higher season-to-season variability relative to other regions at the same latitude. This variability causes difficulty for farmers in decisions regarding planning and managing seasonal activities. Drier seasons result from ENSO events, often dramatically reducing productivity in many systems, especially cropping. Longer ENSO events can lead to drought. For farmers this can also result in the adoption of more conservative mind-sets, with a reduced willingness to take risks, both real and perceived (such as planting a previously untried variety that may be well suited to drier conditions).

Forecasting based on ENSO indicators can be developed on a seasonal-scale. The Philippines meteorological service (PAGASA) issues climate forecasts based on recently developed ENSO knowledge. Despite this questions remain over the value of seasonal climate forecasting (SCF) amongst farmers and policy-makers. Users of SCF have yet to adequately integrate forecasting identifying rainfall odds, based on ENSO, as all uncertainty is not eliminated. A framework that helps them to address such concerns is needed, to build end-user confidence into using and integrating SCF decision-making. The framework is being established to:

- improve the capacity of PAGASA to develop and deliver SCF
- distil key practical and methodological features of economic and psychological approaches to valuing SCF
- estimate the potential economic value of SCF for farm and policy or industry level case studies in the Philippines and Australia
- identify those factors leading to a gap between actual and potential values of SCF
- develop and implement strategies to better match forecasts with decision maker's needs.

Project information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: South Australian Research and Development Institute, Climate Risk Management Unit, Australia

Project Leader:

Peter Hayman
Phone: 08 8431 6926
Fax: 08 8303 9424
Email: hayman.peter@saugov.sa.gov.au

Project Web Site:

<<http://dirp3.pids.gov.ph/ACIAR/>>

Collaborating Institutions

- Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippines
- Philippine Institute for Development Studies, Philippines
- Leyte State University, Philippines
- University of Sydney, Australia
- NSW Department of Primary Industries, Australia

Project Budget: \$833,024

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

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

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

This project was developed on the broad premises that a) Philippines and Australia were both significantly affected by El Niño Southern Oscillation (ENSO), b) there is a lot known in the climate science community about the onset and impacts of ENSO events and c) there was a gap between the knowledge in the scientific community and the application of this knowledge in decision making.

The El Niño event of 2006/07 had an impact in both countries. Although this event developed quickly it was generally well communicated, nevertheless the challenge of how to use this information in

*Subprogram 1: Increasing the market competitiveness of Philippines agricultural products
1A: Better systems and policies for meeting market specifications*

decision making still remains. It is naïve to assume that a modest project such as this can solve the challenge of developing actionable knowledge from climate science, however through a range of case studies and thoughtful analysis, we can contribute to the understanding of barriers and suggestions for success.

We have looked at the use and potential value of seasonal climate forecasts in the following case studies: Corn farm level study in Leyte; Corn farm level study in Isabela; Corn farm level study in Panglao, Bohol; Rice farm and household level study in Nueva Ecija; Rice policy case study in Philippines; Use of seasonal climate forecasts (SCFs) in mixed farm context in Central West NSW; SCFs and opportunity cropping in the Liverpool Plains, NSW; Economic analysis of farming systems in Western NSW; Nitrogen on wheat; Low rainfall farming in South Australia; and Use of SCFs to manage frost risk in southern Australia. In August 2008 a number of these case studies will be formerly presented as part of the Asian Society of Agricultural Economists (ASAE) conference in Manila, Philippines.

The rice policy study, when completed, can provide a very useful input to policymakers since it takes into account not just domestic rice production but also world prices. The rice simulation model highlights the importance of SCFs, domestic production, and external factors as bases for decision to import or not, and the corresponding policy costs of such decisions.

From these case studies we have started to draw together information on the potential value of seasonal climate forecasts. In some cases there is an opportunity to develop operational applications of forecasts, however the case studies were always intended as a means to the end of generalising on the application of seasonal climate forecasts in a range of decision contexts.

Part of this generalising came from the paper comparing seasonal climate forecasts to other innovations that Australian farmers were encouraged to adopt. The use of adoption theory helped us identify characteristics of seasonal climate forecasts as an innovation. We identified that it is difficult to communicate the comparative advantage of probabilistic SCFs and there is a significant cost in terms of time rather than money in developing a working knowledge of SCFs. However, compared to say an innovation such as a new wheat variety, SCFs have economies of scale (can be used across one paddock or a number of farms) and economies of scope (can be used for different enterprises such as cropping or livestock and for different levels of decisions such as fertiliser rates or buying extra land).

In the final period of the project we are looking at ways of summarising and producing guidance material to bridge the gap between the current use and potential value of SCFs in farming systems. It is encouraging that a number of communication tools and frameworks developed in this project have already been used by other groups in the Philippines and Australia.

CIM/2002/106: Fertilisation-independent formation of embryo, endosperm and pericarp for apomictic hybrid rice

Summary

Stagnating productivity of irrigated rice (*Oryza sativa*) over the past decade has seen the rate of increase in production fall below the rate of population increases. This creates concerns for medium to long-term food security.

Throughout Asia rice is the staple crop food, with more than 90 per cent of all rice grown in the region and 50 per cent of dietary calories coming from rice consumption. Hybrid rice, incorporating two or more differing rice lines with traits from both parents, has been shown to provide yield boosts. In China the introduction of hybrid rice accounted for a one-off yield increase of around 30 per cent in production per hectare. Other Asian countries are hoping to use hybrids to reproduce this boost. Most hybrid varieties are intrasubspecific (for instance two lines from the same type – indica/indica). It is expected that these hybrids will be superseded by intersubspecific hybrids that offer greater advantages through combining two lines of different types with a combined traits of both parents.

Making high-yielding hybrid varieties available to the poor may be helped by one-line or apomictic production. This is potentially cheaper and more flexible than multi-line hybrids while still offering the same advantages. One line hybrids reproduce asexually through apomixis (fertilisation of the egg by non-sexual means). In rice this process is possible through synthetic activation of apomixis. Achieving this in single line hybrids would be cheaper and more likely to ensure equal yields than in multi-line hybrids. Through this project research will address key issues in developing apomictic rice, focusing on the role of fertilisation independent genes in other plants for their application to hybrid rice.

Project information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: International Rice Research Institute, Philippines

Project Leader

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Collaborating Institutions

- CSIRO Plant Industry, Australia
- International Rice Research Institute, Philippines

Project Budget: \$1,500,001

Project Duration: 01/07/2003 to 30/09/2008 (Project extended from 30/06/2008 to 30/09/2008)

ACIAR Research Program Manager: Dr Paul Fox

Project progress

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

Annual report not yet submitted by the project leader.

CIM/2006/176: Developing molecular markers to enable selection against chalk in rice

Summary

Rice is valued at every stage from production to consumption on the basis of two traits – the proportion of broken grains and chalky grains. The starch in the chalky, opaque areas is loosely packed so chalky grains generally break during milling. Chalk occurs during grain development and no breeding program has been able to overcome it. Chalk affects subsistence farmers who mill their rice by traditional pounding because pounding pulverises chalky grains; also those who pay a miller with a portion of their milled rice must pay a larger proportion of a low-value chalky sample than of a high-value sample.

Minimising the occurrence of chalk would increase food security and potential income by increasing the yield of edible rice per hectare, possibly by as much as 7%.

Chalk occurs in high temperatures during grain filling. Earlier research found that tropical germplasm (tropical japonica and indica) is more chalk prone than temperate japonica germplasm. Therefore, to protect food security in developing countries where tropical rice is the staple, as well as the security of the world rice supply, it is imperative to resolve the genetic/physiological difference between temperate and tropical germplasm for low chalk, especially as our world gets warmer.

Much of the foundation plant material has already been developed and identified, and this project will further advance the work through the following objectives:

- discover genetic segments and allelic variation in tropical and temperate germplasm that lead to low chalk independently of environmental conditions
- design markers to search for variability in the genetic segments associated with chalk in diverse germplasm
- develop and validate markers for low chalk to enable incorporation of favourable alleles into agronomically superior germplasm that will ultimately be delivered to National Agricultural Research and Extension Systems (NARES)
- deliver markers to Australian collaborators for validation and optimisation in the temperate japonica genetic background.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation:
International Rice Research Institute, Grain Quality, Nutrition and Postharvest Centre, Philippines

Project Leader

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Collaborating Institutions

- NSW Department of Primary Industries,
- Yanco Agricultural Institute, Australia

Project Budget: \$998,960

Project Duration: 01/05/2007 to 31/05/2012

ACIAR Research Program Manager: Dr Paul Fox

Project progress

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

Three sets of introgression lines with a total of 750 lines were provided from a joint IRRRI China research project, along with linkage maps. These were planted in the dry season of 2007, and were found to be very mixed. During the growing season, off-type plants were removed in an attempt to achieve uniformity in each plot.

Grain was harvested for chalk measurements from several plants in the plot, 10 panicles were randomly selected from the plot for DNA extraction, and a single plant was selected for replanting to ensure the plots were pure in the next season.

A plot was generated from each of those single plants in the wet season, panicles were collected to relate panicle architecture to chalk, and grain was collected for measuring chalk. Chalk values vary across the spectrum from quite translucent all the way to very chalky. For some lines, the chalk value was similar for both the wet and dry season; for the rest, the chalk values were higher in the dry season. No lines gave lower chalk in the dry season than in the wet season.

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1A: Better systems and policies for meeting market specifications*

When attempting to use the chalk data and the linkage map to find genetic regions that associate with chalk, we discovered that the samples were not just individually mixed, but there were many inconsistencies in the populations. We were therefore unable to associate genotype with phenotype. We have two options: sort out the problem or create our own genetic map. We have opted for the latter.

Despite the issues with the labelling of the populations, we have two seasons of data and excellent segregation, independent of grain shape, for both chalk and panicle architecture, and we are creating a minimal genetic map using 40 SSR markers. We intend to use that map and the phenotype data to select a subset of the 750 lines for growing in the glasshouse in the second year and for carrying out detailed phenotyping. SNP markers will be added to the framework SSR map.

HORT/2001/049: Development of PRSV-P resistant papaya genotypes by introgression of genes from wild *Carica* species

Summary

Papaya is the fourth most important crop in the world production of tropical fruits, with 5 to 6 million tonnes being produced per year. The most serious disease that threatens the world production of papaya is PRSV-P, a virus which is spread by aphids. This disease is rapidly spreading and devastating papaya production worldwide.

Papaya is a major fruit crop of the Philippines and is used for local consumption as well as export. During the last 20 years PRSV-P has caused the death of the whole papaya industry in some of its island regions and has severely decreased production in many other areas.

In Australia, where papaya production has been increasing steadily, the disease has been confined to Southeast Queensland. However, if the disease would transfer to North Queensland, where 80% of production occurs, it would devastate the Australian industry.

Consequently, the development of resistant genotypes is a research priority in both countries. Resistant genotypes have been produced by genetic transformation, however there remains a consumer resistance to genetically modified fruit crops worldwide. The plants produced by this project will be the result of traditional plant breeding systems.

The main aim of this project is to develop stable and fertile backcross lines of papaya that are resistant to the papaya ringspot virus, form P (PRSV-P) and could be used as genetic stocks for papaya improvement. It also aims to produce elite genotypes of papaya for Australia and the Philippines which are resistant to PRSV-P, to trial these on growers' properties and to enable the transfer of associated technology to the Philippines.

This project relies on the results of a previous project in which a fertile PRSV-P resistant hybrid between papaya (*Carica papaya*) and *C. quercifolia* was developed.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: Griffith University, School of Biomolecular and Biomedical Science, Australia

Project Leader

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Collaborating Institutions

- University of the Philippines at Los Banos, Philippines
- Bureau of Plant Industry, Philippines

Project Budget: \$655,167

Project Duration: 01/01/2002 to 30/06/2009 (Project extended from 01/07/2006 to 30/06/2009)

ACIAR Research Program Manager: Mr Les Baxter

Project progress

Year 6 (01/01/2007-31/05/2008)

Sub-Project 1. Selection of backcross generations for PRSV-P resistance and good agronomic traits

Field performance of BC₃ and BC₂ sib-cross plants against papaya ringspot virus (PRSV-P) was evaluated. BC₃ plants are the product of introgressing the PRSV-P trait from the papaya wild type *Vasconcellea quercifolia* to *Carica papaya*. BC₂ sib-crosses were developed by sib-crossing selected female and male BC₂ plants. Selection was based on ELISA test result and symptom development in the field.

A total of 634 plants (88 BC₃, and 546 BC₂ sib-crosses) were inoculated three times at two weeks interval in the greenhouse. Three hundred twenty-five (46 BC₃ and 279 BC₂ sib-cross) or 51.3% showed typical symptoms, which ranged from distortion of young leaves, mosaic, chlorosis to shoe-stringed on older leaves. Plants that remained healthy and symptom free together with the susceptible check, Davao Solo, were then transplanted in the field and were assessed for resistance/susceptibility to the Philippine strain of PRSV-P. A total of 81 BC₂ sib-crosses and 34 BC₃ plants were planted in Mainit, Bay, Laguna. Initial results showed that, there was variation in the rate of symptom development in BC₃ and BC₂ sib-crosses from the control. Davao Solo

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produced severe symptoms after 1-2 months of transplanting in the field while there were BC₃ and BC₂ sib-cross plants that remained symptom free for about 7-8 months. The difference between backcross papaya and Davao solo was also evident in the ability of the trees to bear good quality fruit. Davao Solo produced a few small and unmarketable fruits. Backcross plants in contrast to the Davao Solo had the ability to recover from early infection based on visual inspection and serological test (ELISA).

Fruit qualities of some backcross plants and DS were evaluated. Fruit weight of backcross plants ranged from 834.53-754.92 grams in contrast with DS's 202.67 grams. Fruits have firm yellow orange flesh, with mild papaya aroma. TSS (⁰B) values of BC₃, BC₂ sib-cross lines and DS were 10.0, 12.2, and 9.3 respectively which corresponds to sweet taste for backcross lines and not so sweet for DS.

A total of 401 BC₃ sib crosses and 355 BC₄ plants are now being grown and will be inoculated manually three times in the screenhouse. The surviving plants will be transplanted in the field where its resistance/susceptibility against Philippine strain of PRSV-P will be tested.

Sub-Project 2. Backcross fertile resistant C. papaya x V. quercifolia F1 hybrids to C. papaya

IPB inbred lines (4172, 5648 and 5893) were planted in the field last April 15, 2007, to be used in the continuing effort of introducing PRSV-P resistance gene(s) in other elite papaya lines.

Sub-Project 3. Development of molecular markers for PRSV-P resistance

An attempt to develop a molecular marker was successfully completed. To confirm introgression, genetic fingerprinting of several genotypes of *C. papaya* and some of its wild relatives was carried out using simple sequence repeats (SSRs).

Preliminary result indicated introgression of a putative nucleotide fragment (150bp) from *V. quercifolia*, hypothesized to mark for PRSV resistant attribute of both *V. quercifolia* and F1 intergeneric hybrids (410, 468 and 469). In the resistant backcross progenies, a putative nucleotide fragment (100 bp) was observed to be consistent. This 100 bp could be a fragment of that putative nucleotide fragment from *V. quercifolia* which could explain the resistance of the backcross plants.

Sub-Project 4. Micropropagation of elite papaya genotypes

Micropropagation of some BC₃ (5648 x BC2 03R-73), BC₃ sib-cross plantlets, F1 intergeneric hybrids (404, 410, 468, 469, and 507) and RR papaya cultures (cross between two *Vasconcellea* species) from Australia is continuing. Clonal micropropagation of BC₁ is also in progress.

Sub-project 5. Evaluation on Grower's Properties

Re-constituted "Sinta" (BC₂ 03R lines crossed with 4172) is now being tested along with the original "Sinta" in the farmer's field in Batangas. Evaluation of resistance of these Re-constituted "Sinta" is still on-going. Fruit evaluation of this line was also Completed.

HORT/2003/071: Integrated pest management and supply chain improvement for mangoes in the Philippines and Australia

Summary

Mangoes are a popular fruit in many tropical countries in Asia and in Australia. The Philippines has a mature mango industry based on the Carabao cultivar. A large proportion of this industry is based in Luzon on the southern island of Mindanao and Guimaras in the Visayas. Smallholder production, defined as farms less than three hectares, accounts for 48 per cent of total Philippines production. The Philippines produces around 880,000 tons each year. Of this between 36,000 to 40,000 is exported, making the country the world's second largest exporter after Mexico, representing around 5.9 per cent of global trade. There is significant scope to increase this production and trade further, as pest and disease losses, production variability, fruit perishability and supply chain management all limit potential. The Australian industry does not have the breadth of problems but does have some pest control and quarantine issues.

Insect pests are a significant problem in both countries. A field infestation has the potential to cause losses of between 10 to 40 per cent. These can also limit market access domestically and internationally. Pesticides are frequently used, often to excess, prompting concerns relating to pesticide residues. New pests emerging in the Philippines also require that Integrated Pest Management strategies address new threats and excessive pesticide use. In addition improvements in the supply chain are likely to help reduce losses and foster better pre and postharvest practices at all levels. The sustainability of mango industries in the Philippines and Australia will be enhanced through a systems approach to improving pest management and the consistency of supply and quality of mangoes for targeted markets.

Project information

Overseas Collaborating Countries:
Philippines

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

Project Leader

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Collaborating Institutions

- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Philippines
- Department of Agriculture, Fisheries and Forestry, Australia
- Department of Agriculture, Philippines
- Bureau of Plant Industry, Philippines
- University of the Philippines at Los Banos, Philippines

Project Budget: \$1,157,768

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

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

Annual report not yet submitted by the project leader.

HORT/2007/066: Enhanced profitability of selected vegetable value chains in the southern Philippines and Australia program

Summary

In the Philippines the vegetable industry plays an important role in domestic and export markets, both economically and nutritionally. The Philippines Government and other industry stakeholders have identified the domestic market as a high priority for development and improvement due to the number of households involved in vegetable production. There is also potential for export market development. Areas that have been identified as constraints include production efficiency and sustainability, food quality, food safety, postharvest loss and domestic consumption. This is a program approach which aims to develop integrated and systems approaches to address value chain constraints. It has six components:

Component 1 - Integrated soil and crop nutrient management in vegetable crops in the southern Philippines and Australia

The aim is to develop integrated soil and crop management strategies in vegetable crops in the southern Philippines and Australia. It will define current soil fertility status and management practices, and develop and promote best management practices that suit local conditions.

Component 2 - Development of a cost-effective protected vegetable cropping system in the southern Philippines and Australia

The aim is to develop, evaluate and implement a protected cropping system to allow farmers in high rainfall areas to produce high value crops in the wet season when prices are high. These systems will also be modified for use in Australia.

Component 3 - Integrated strategies for the management of bacterial wilt and other wilting diseases in Solanaceous crops in the southern Philippines and Australia

This will build on the strong foundation laid down by previous projects to develop integrated crop management systems for bacterial wilt in potatoes in southern Philippines and Australia. It will also develop robust management strategies for the control of bacterial wilt in tomatoes.

Component 4 - Analysis of selected vegetable value chains in the southern Philippines and Australia

The aim is to assess the institutional market for high quality vegetables, describe and evaluate

the performance of traditional and institutional vegetable chains, improve the capacity of smallholder farmer to access these markets, and identify and propose interventions to improve the performance of value chains.

Component 5 - Economic impacts of new technologies and policy constraints in the production of vegetables in the Philippines and Australia

The aim is to measure the profitability of technologies developed in components 1 to 4 and use this to influence the research process, enhance the adoption of technologies and identify policy constraints and options for change.

Component 6 - Program management

The aim of this Component is to provide details of management, communication and strategies for ensuring integration of components 1 to 5, and identification of opportunities for efficiency and effectiveness gains through sharing of resources, trial sites and extension activities.

Where possible, the linkages between components will be identified and integrated into appropriate adoption and extension strategies. A key aim of this Program is to develop integrated and systems approaches to interventions addressing value chain constraints. Extension and adoption activities are areas which offer considerable potential for component linkages, integration and efficiency in terms of funding and resourcing. Appropriate partnerships and collaborations will be developed with commercial and agri-business partners such as Del Monte, Dole and East West seeds to help ensure sustainability and commercialisation of Program outcomes.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: NSW
Department of Primary Industries, Gosford
Horticultural Institute, Australia

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1B: Higher returns from horticulture products*

Project Leader

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Collaborating Institutions

- Applied Horticultural Research, Australia
- Curtin University of Technology, Australia
- NSW Department of Primary Industries, Australia
- Queensland Department of Primary Industries and Fisheries, Australia
- University of the Philippines, Los Banos, Philippines
- Visayas State University, Philippines
- University of the Philippines, Mindanao, Philippines
- Catholic Relief Services, Philippines
- World Agroforestry Centre, Philippines
- Department of Agriculture, Philippines
- Northern Mindanao Vegetable Producers Association (Normin Veggies), Philippines
- Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines
- Philippine Institute for Development Studies, Philippines
- Northern Mindanao Integrated Agricultural Research Centre, Philippines

Project Budget: \$4,293,429

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

ACIAR Research Program Manager: Mr Les Baxter

Project progress

First progress report due in 2009.

HORT/2007/067: Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia program

Summary

The goal of the Program is to contribute to economic growth in the Philippines through increased income and improved livelihoods of tropical fruit growers in southern Philippines. The purpose of the Program is to improve the smallholder and industry profitability and export competitiveness of selected tropical fruits industries in the southern Philippines. Fruit crops to be targeted are mango, papaya, durian and jackfruit. The primary audience for the outcomes of this Program are medium to large scale commercial fruit growers and farmers predominantly in the regions of Leyte (VIII), northern Mindanao/Cagayan de Oro (X) and southern Mindanao/Davao (XI). The Program has six components:

Component 1 – Analysis of the constraints to selected tropical fruit (papaya) supply chains and implementation of improved quality systems for the southern Philippines and Australia.

The aim is to identify and analyse the constraints limiting the competitiveness of papaya supply chains for the Philippines (as a model for other tropical fruit supply chains) with particular emphasis on how Philippines growers could create and receive increased value from the supply chains to which they belong.

Component 2 – Integrated management of Phytophthora diseases of durian and jackfruit in the southern Philippines.

The aim is to increase the productivity of jackfruit growing in the eastern Visayas and durian productivity in Mindanao.

Component 3 – Integrated crop management strategies for productive, profitable and sustainable production of high quality papaya fruit in the southern Philippines and Australia.

The aim is to increase the profitable and sustainable production of papaya fruit in the southern Philippines and Australia through the development of integrated crop management strategies for the control of bacterial crown rot and Phytophthora-related diseases and major insect pests.

Component 4 – Improved and sustainable value chains for mango production in the southern Philippines and Australia.

The aim is to enhance the sustainability of the mango industry in the southern Philippines and Australia through a systems approach that will improve pest and disease management and the consistency of the supply of quality mangoes for targeted markets.

Component 5 – Economic impacts of new technologies and policy constraints in the production of fruit in the southern Philippines and Australia.

The aim of this economic/policy research component is to improve the impact of the whole Program by measuring the profitability of technologies developed in Components 1 to 4 and use this to influence the research process, enhance the adoption of technologies and identify policy constraints and options for change.

Component 6 – Program Management.

The aim of this Component is to provide details of management, communication and strategies for ensuring integration of Program Components and maximisation of resource use.

Where possible, the linkages between Components will be identified and integrated into appropriate adoption and extension strategies. A key aim of this Program is to develop integrated and systems approaches to interventions addressing value chain constraints. Extension and adoption activities are areas which offer considerable potential for Component linkages, integration and efficiency in terms of funding and resourcing. Appropriate partnerships and collaborations will be developed with commercial and agri-business partners such as Del Monte, Dole and Bounty Fresh Harvest to help ensure sustainability and commercialisation of Program outcomes. The Program will also seek linkages with other donors and relevant projects/programs.

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1B: Higher returns from horticulture products*

Project Information

Overseas Collaborating Countries:
Philippines

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

Project Leader

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Collaborating Institutions

- Queensland Department of Primary Industries and Fisheries, Australia
- University of Queensland, Australia
- University of Sydney, Australia
- Bureau of Plant Industry, Philippines
- Leyte State University, Philippines
- University of Southern Mindanao, Philippines
- University of the Philippines at Los Banos, Philippines
- Del Monte Philippines Inc, Philippines
- AKC Consulting Pty Ltd, Australia
- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Philippines
- Department of Agriculture, Philippines
- Provincial Agriculture Office, Philippines
- NSW Department of Primary Industries, Australia
- Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines
- Philippine Institute for Development Studies, Philippines
- Visayas State University, Philippines
- University of the Philippines, Mindanao, Philippines
- University of Southeastern Philippines, Philippines
- University of Southern Philippines, Philippines

Project Budget: \$326,585

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

ACIAR Research Program Manager: Mr
Les Baxter

Project progress

First progress report due in 2009.

FIS/2002/077: Improved hatchery and growout technology for marine finfish in the Asia-Pacific region

Summary

Aquaculture is an important source of supply, particularly of high-value marine finfish. Interest in pursuing this has grown, reflecting both the incomes on offer to smallholders and the potential easing of pressure on wild stocks, both driven by the lucrative (up to US\$70/kg) paid in some parts of Asia.

The sustainability of aquaculture production continues to grow, as research delivers improvements to fish grow-out survival rates. ACIAR-supported research (FIS/1997/073) developed improved diets and rearing strategies for some species. Despite this success some problems remain to be addressed: wild fry and fingerlings being used as a source of seed stock, the poor survival in rearing from larvae and the role of trash fish (low value species usually found as by-catch in fishing for higher-value species).

With marine finfish playing an important role in the economic well-being of many coastal communities, ensuring the sustainability of aquaculture is important to maintaining wild fisheries. Without such production fishing pressure on wild stocks will increase, fisher folk will increasingly be forced to trawl for trash fish and increasing numbers of wild fry and fingerlings will be removed from wild populations to act as a source of seed stock.

The overall objective of the project is to enhance the sustainability of marine finfish aquaculture in the Asia-Pacific region by improving hatchery production technology and facilitating the uptake of compounded feeds for grow-out.

Project Information

Overseas Collaborating Countries: Indonesia, Philippines, Thailand, Vietnam

Commissioned Organisation: Queensland Department of Primary Industries and Fisheries, Agency for Food and Fibre Sciences - Fisheries and Aquaculture, Australia

Project Leader

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Collaborating Institutions

- Southeast Asian Fisheries Development Centre, Philippines
- Central Research Institute for Aquaculture, Indonesia
- Research Institute for Aquaculture No. 1, Vietnam
- Network of Aquaculture Centres in Asia Pacific, Thailand
- Sam Ratulangi University, Indonesia
- Research Institute for Coastal Aquaculture, Indonesia
- Gondol Research Institute for Mariculture, Indonesia
- CSIRO Marine Research, Australia
- Directorate General Aquaculture, Indonesia

Project Budget: \$959,214

Project Duration: 01/07/2004 to 31/12/2009 (Project extended from 29/09/2008 to 31/12/2009)

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

Larval rearing research continues to focus on improving larval survival and improving the quality of fingerlings produced in hatcheries. While some improvements have been made, progress has been limited due to unreliable egg production at some of the partner institutions. Research into the enzymic capacity of larval groupers is continuing at NFC Cairns, to support the use of inert diets as part of the larval rearing regime. This work has demonstrated that coral trout have lower levels of enzyme activity over the first 12 days post-hatch than tiger grouper (*Epinephelus fuscoguttatus*), which may help explain why *Plectropomus* species are more difficult to rear than other groupers.

Research into developing cultures of small (S-strain) and super-small (SS-strain) rotifer (*Brachionus rotundiformis*) has shown that most techniques to select for smaller rotifers have little or no long-term effects on population size. The most

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promising technique for reducing rotifer population size is isolating and culturing specific strains. Future work will examine whether strain hybridisation can reduce overall rotifer population size.

Collection and cold storage of amictic rotifer eggs was also evaluated. However, cold storage of amictic eggs was found to be effectively limited to 24 hours.

Techniques to culture small copepods – the calanoid copepod *Parvocalanus* – have been developed at NFC Cairns. Cultures of *Parvocalanus* are routinely used in larval rearing in Cairns and have replaced the use of *Acartia* for larval rearing. Two staff from Research Institute for Aquaculture No.1, Cua Hoi and Cat Ba hatcheries, in Vietnam, were trained in live food culture, including copepod culture techniques, at NFC Cairns.

Research into development of grow-out diets has focussed on trialling commercial pellet feeds against research diets or 'trash' fish. Results from commercial diets remain mixed. Coral trout (*Plectropomus leopardus*) fed a commercial pellet feed and a custom-made (RIM-Gondol) feed showed similar survival (46–49%), weight gain (411 and 422%), daily growth rate (1.38 and 1.41 g/day) and FCR (1.55 and 1.45).

However, in another trial RIM Gondol undertook a comparison of pellet diet and 'trash' fish fed to coral trout and coral grouper (*E. corallicola*). 'Trash' fish outperformed the commercial pellet with both species. Coral trout fed 'trash' fish were substantially larger (554 g) after 180 days than those fed the pellet (diet 366 g). Survival rate was similar: 72 – 75%. Growth differences in *E. corallicola* were less marked with fish fed 'trash' fish reaching 316 g compared with pellet fed fish 278 g after 180 days. However, survival of fish fed 'trash' fish was higher (96%) than those fed pellets (82%).

Trials at RICA Maros showed that tiger grouper fed commercial feed (dry pellet), moist pellet, or 'trash' fish have relatively similar whole body content of lipid and protein. Meat quality of fish fed commercial pellet, fed moist pellet, or 'trash' fish was well accepted generally by taste panellists and grouper consumers in Hong Kong.

Three issues of the APMFAN eMagazine (Nos. 9-11) and seven editions of the APMFAN eNews (Nos. 32 – 38) were produced during 2007–08. The Marine Finfish section of the eNACA web site continues to be a popular source of information on marine finfish aquaculture and a valuable mechanism for distributing extension information.

NFC Cairns provided on-farm training to two farmers on culture techniques for grouper with particular reference to methods of cage culture and fish grading. Also, training was provided to a barramundi hatchery operator on the culture of tiger grouper. This training provided the first fingerlings of tiger grouper produced by a commercial operator in Australia.

RICA Maros held a short training course for farmers from Sengata Regency (Kalimantan Timur Province) on feed preparation and feed management, 30 July – 5 August 2007 (in Sengata and Maros).

The APMFAN Grouper Hatchery Production Training Course was held twice during 2007–08: 9–29 July 2007 and 5–25 May 2008, at the Brackishwater Aquaculture Development Centre, Situbondo, East Java, Indonesia. As always, these courses were well attended by trainees from throughout the Asia-Pacific region.

FIS/2003/033: Integrated fisheries resource management (Rinconada Lakes, Philippines and NSW Australia)

Summary

World Bank economic studies of the Bicol River basin have identified the Rinconada System (Lakes Buhi, Bato & Baao-Bula) as ranking second in terms of the incidence of poverty in the Philippines. People in the surrounding communities rely on the lakes for employment, food or navigation access. Management of the system is a compromise between necessary fisheries production through wild harvest and aquaculture and other primary uses of the lakes such as irrigation and hydro-electric power generation versus conservation/sustainability objectives. Overfishing of wild fish stocks, and the increase in cage-based fish farming (tilapia), together with siltation caused by poor land-use practices in the catchment area, have caused serious habitat deterioration and a significant decline in fisheries production. The habitat deterioration is evident from eutrophication (algal bloom), reduced fish catches, reduced growth of fish in cages, fish kills and massive colonisation of lakes by water hyacinth.

A management plan has been initiated in Lake Buhi and a draft plan formulated for Lake Bato, but local stakeholders show little inclination to adhere to the plans. Municipal officers are insufficiently equipped to enforce national regulations (and in many cases do not understand the issues). Other stakeholders, including fish farmers and fishers, have a poor understanding of the issues and there is little effective compliance or incentive to change practices.

Project objectives are to facilitate adoption by key stakeholders of actions to improve management of the Rinconada Lakes and also of selected fisheries resources in NSW, Australia; to facilitate improved fish cage management, to increase economic return and reduce impacts on water quality and effectively manage water hyacinth infestations in Rinconada system by physical removal; to document and package the ecosystem-based management findings and outcomes ready for adoption.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: NSW Department of Primary Industries, Cronulla Fisheries Centre, Australia

Project Leader

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Collaborating Institutions

- Bureau of Fisheries and Aquatic Resources, Philippines
- Econcern Pty Ltd, Australia

Project Budget: \$484,242

Project Duration: 01/07/2006 to 30/06/2009

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

The project Memorandum of Agreement with the Bureau of Fisheries and Aquatic Resources in the Philippines was signed in September 2006 and the official project launch was in February 2007.

The study area is in the Camarines Sur and Albay provinces (Bicol region) of the Philippines. The three Rinconada Lakes (Buhi, Bato and Baao – Bula) are located within the five local government Municipalities of Buhi, Bato, Baao, Bula and Libon and involvement of municipal staff in the project has been negotiated.

Unfortunately for the second year in a row the Bicol region was impacted by a sequence of significant natural disasters which caused considerable loss of infrastructure and many human deaths. The major concern was flooding, which had a duration of 30 days (February to March 2008) and was rated as a red alert severity class 1 by the Global Disaster Alert and Coordination System (GDACS).

As a consequence of these natural disasters the project objectives and scheduling of work tasks had to be

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reassessed for a second time and modified to accommodate the changes in the study area associated with the disruption to peoples livelihoods, damage and loss of fish cages and the virtual total flushing of the water hyacinth from the Rinconada Lake system.

After the redrafting of the project methodology and work tasks, official briefings of the Bureau of Fisheries and Aquatic Resources regional staff and the local government officials of the four Municipalities (Buhi, Bato, Baa and Bula) including the incumbent Mayors and our participating fisherfolk were re-done.

The stocking density trials in Lake Bato and Buhi with four fish farmer co-operators in each Lake were completed in September / October 2007 after an approximate 5 month grow out.

The results in Lake Buhi indicate significant interactions between sites and stocking density. Growth was highest in the 10 fish/m² stocking density with supplementary feeding compared to the 5 (natural feed only) and 15 (supplementary feeding) fish/m² treatments. Site differences in water quality, especially dissolved oxygen, may be related to the variable survival data in individual cages (23.3% to 90.0%). An average feed conversion ratio of 2.9 was achieved across all cages. However, this value needs to be taken very cautiously since there were instances when feed delivery was delayed and there were days when the fish were not fed or the co-operator did not follow the feeding protocols.

In Lake Bato different analyses of data are necessary since the husbandry, feeding and harvest protocols established and agreed for the experiments were modified during the experiment by the co-operating fishermen. However, the general trends in the data suggest the best survival and growth rates were achieved in the 10 fish/m² stocking density with supplementary feeding and this stocking density also provided the most cost effective feed conversion ratio.

The feeding experiment trials working with co-operating fishermen commenced in March 2008 and will go for approximately 5 months. The trials are based on a modified design to minimise the problems encountered in the stocking density trials. The experiment involves 24 reduced size fish cages in each lake stocked at 10 fish/m² (4 feeding regimes x 3 replicates x 2 co-operators). Some difficulties in the supply of sufficient Tilapia fingerlings has been experienced and a delay in stocking the cages in Lake Buhi has occurred.

Monthly water quality monitoring is ongoing and the public dissemination of the data via the bulletin boards at the fish landing jetty or municipal offices is occurring. Unfortunately the water quality laboratory in Bato was flooded in the natural disaster in March 2008 and suffered significant damage. However, all the equipment was relocated and saved from water damage.

The water quality in Lakes Buhi and Bato during the summer months May / June deteriorated significantly, with dissolved oxygen levels falling below 5 mg/l in surface waters and below 1 mg/l in bottom waters. This was the most likely cause of the observed fish kills. During the start of the rainy season (July) the dissolved oxygen levels improved. Throughout the stocking experiment ammonia levels were variable in both lakes and often exceeded the preferred range for Tilapia culture.

Plankton sampling as an indicator of natural 'wild' food availability showed the dominant microalgae in Lake Bato are the diatom *Nitzschia* sp., and the Cyanophyte *Oscillatoria* sp.. Other species found were *Aulacoseira*, *Asterionella*, *Volvox*, *Gymnodinium*, *Coelastrum*, *Pediastrum*, and *Closterium*. In Lake Buhi the centric diatom *Aulacoseira* sp, the pennate diatom *Fragillaria* sp. and the chlorophyte *Oocystis* were dominant though plankton density was higher in this deeper less turbid Lake.

Substantial progress was made on the water hyacinth composting objective in September / October 2007 when Mr Ren Waterfall (Earthmakers) was successful in designing the water hyacinth chopper and conveyor system and working with Tropics Agro Industries, Naga and Morallo Industries, Pili on quoting for the manufacture of the equipment.

A successful meeting and discussion was held between Earthmakers and Mr Glen Calleja Eco Fish Park, Pili re the use of Mr Calleja's probiotics (microbial accelerants) for inclusion in the compost trials. However, the location and timing of the water hyacinth composting trials is being reviewed following the flushing of water hyacinth from the study Lakes in March 2008 by the continuing natural disasters (typhoons and floods) in the Bicol region.

FIS/2003/059: Sea ranching and restocking sandfish (*Holothuria scabra*) in Asia-Pacific

Summary

Overfishing of sea cucumbers and consequent lost livelihoods of artisanal fishers have precipitated a crisis throughout the tropics. Underscoring the severity of this problem, the United Nations-FAO and ACIAR have undertaken a range of initiatives to improve tools for managing sea cucumber fisheries.

Stocks of one sea cucumber, the 'sandfish' (*Holothuria scabra*) – a high-value species easily harvested from inshore habitats – have been chronically over-exploited throughout the Asia-Pacific. A priority is better fisheries management, and aquaculture and stocking technologies can motivate communities into conserving wild breeding stocks while generating income and speeding stock recovery. Commercial operations have recently invested in on-growing sandfish within leased sea beds, referred to as 'sea ranching'. Using optimal hatchery and stocking methods, this nascent approach could be economically viable. Alternatively, breeding populations in reserves could be 'restocked' to rejuvenate larval supply to nearby fishing grounds. In addressing these possibilities, this project is designed to apply the technology arising from two earlier ACIAR projects – one for producing sandfish in hatcheries (FIS/1995/703) and the other for releasing them in the wild (FIS/1999/025).

The two major objectives are:

- to test a new livelihood option in the Philippines and Australia through releasing cultured sandfish in managed inshore habitats then allowing communities to harvest them at market size after 3 years
- to replenish selected sandfish populations in the Philippines through restocking into marine reserves, designed to rebuild a critical mass of spawning adults.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: WorldFish Center, Philippines

Project Leader

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Collaborating Institutions:

- Department of Agriculture, Fisheries and Forestry, Australia
- University of the Philippines, Philippines
- University of the Philippines, Mindanao, Philippines
- James Cook University, Australia
- Tasmanian Seafoods Pty Ltd, Australia
- National Fisheries Research and Development Institute, Philippines

Project Budget: \$937,549

Project Duration: 01/06/2007 to 31/05/2011

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

Since Project start-up on 1st June 2007 and the conduct of Project Inception meeting on 30 July – 3 August 2007 at the UP-MSI Bolinao Marine Laboratory, Philippines, the following has been accomplished and they are elaborated in the Annex sections of this report:

- Completed upgrading of the hatchery and initiated production of sandfish juveniles at the UP-MSI Bolinao Marine Laboratory as well as sea ranching activities in two villages (i.e., Victory and Silaki) in Bolinao, Philippines
- Initiated production of sandfish juveniles for Davao node, preparation of High ponds for larval/juvenile rearing, and initial consultations with communities in Barangay Bato, Davao, Philippines)
- Initiated construction of hatchery at NIFTDC in Dagupan, Philippines and aided NFRDI to produce sandfish juveniles
- Site assessments for potential restocking experiment were conducted in Northern Luzon, Philippines

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- NT node coordinator continued contact with project key personnel in Australia (i.e., Warruwi Community, DAFF and Tasmanian Seafoods) while awaiting project funding from the Aboriginal Business Account
- Organization and conduct of the “Hatchery Operations Training” from 24 March to 15 April 2008 at NIFTDC and UP-MSI Bolinao Marine Laboratory. The training was participated by key project staff from the Philippines, i.e., NFRDI, UP-MSI and UP-Min including BFAR Regional staff
- Organization and conduct of the “Release Strategy Workshop” on 14-18 April 2008 at NIFTDC in Dagupan and UP-MSI Bolinao Marine Laboratory. The workshop was participated by key research partners in the Philippines and Australia including scientist from Indonesia, Malaysia and Vietnam
- Participation of key project staff in various national meetings/reviews and planning sessions in support of the National Extension and Advisory Group.

FIS/2007/045: Evaluation of production technology, product quality and market potential for the development of bivalve mollusc aquaculture in the Philippines

Summary

Bivalve aquaculture has potential to sustain small-scale coastal communities across the Philippines and contribute to economic growth, provided problems of production, regulation, postharvest practices, food safety and marketing can be identified and addressed.

This scoping study will examine bivalve industries in Visayas and compare them with better performing regions in Luzon. Collected data will be analysed and used to develop a clearer understanding of the factors underlying the relative underperformance of these industries in terms of productivity and economic performance, and to identify priorities for future research.

Project Information

Overseas Collaborating Countries:
Philippines

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

Project Leader

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Collaborating Institutions

- University of the Philippines in the Visayas, Institute of Fisheries Policy and Development Studies, Philippines

Project Budget: \$50,497

Project Duration: 01/06/2007 to 31/12/2008
(Project extended from 01/07/2008 to 31/12/2008)

ACIAR Research Program Manager: Mr Barney Smith

Project progress

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

The project commenced in August 2007, slightly later than the originally anticipated July start.

The project objectives are summarised below, followed by a summary of progress to date:

1. Collect comparative information, including quantitative data and site selection issues, on bivalve production methods in Western Visayas and Luzon.
2. Collect and compare information on product quality, safety and post-harvest aspects of bivalve production between these regions and compare with international standards.
3. Determine domestic and international market potential for Philippine bivalve species.
4. Analyse legal and policy framework for aquaculture management, environmental impact, production, processing and marketing to determine compliance and regulatory influence on regional production and competitiveness.
5. Develop second-phase proposal for quantitative assessment of critical factors affecting quantity and value of bivalve aquaculture.

Study sites have been selected in both Luzon and Visayas. The Luzon sites are at Bolinao and Anda, in north-west Luzon, Malolos and Bacoor, to the west and south of Manila respectively. In the Visayas, sites were selected in two coastal municipalities on the islands of Panay (Batan) and Negros (Himamylan). The sites were selected using a variety of criteria including; having established mollusc culture, fairly typical site characteristics (ie absence of atypical features), accessibility, local support facilities and collaborative producers.

To capture any seasonal variability, sampling was intended for both wet (approx. June - November) and dry seasons (December - May). All sites have been sampled at least once, with Luzon being sampled during August 2007 and April 2008. Visayas sites were sampled in December 2007 and are scheduled again for June 2008. Sampling, from 5 stations at each site, consisted of mussel and oysters collection (either both or one depending on local industry characteristics) for both

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microbiological (e.g. total coliforms, *Vibrio* counts, *Salmonella*) and morphometric data (shell length, wet weight (whole and tissue), shell dry weight). Water quality parameters were also measured at each station covering a depth profile, and included dissolved oxygen, pH, conductivity, temperature, turbidity and water microbiological assessment. Sediment samples have also been collected from all stations and are currently being analysed for microbial and chemical content and activity.

During field work periods, communication was made with local mollusc farmers, including those providing the oyster and mussel samples, and interviews were conducted with them. The interview instrument, a validated questionnaire, covers all aspects of mollusc aquaculture production, including environmental, economic, social and culture practices. To date more than 200 interviews have been conducted. A similar process will shortly be conducted with the brokers and wholesalers of oysters and mussels to obtain information on the sale and marketing aspects of the industry.

Site visits have also included the establishment of communication with local administrative and regulatory authorities, including barangay, municipal and central government agencies. These agencies have provided information, including statistical data, on aspects such as coastal-activity zonation, numbers and type of aquaculture producers, local management, regulatory and environmental issues, industry extension activities and marketing organisations and practices.

A full project team meeting occurred in December 2008 in Iloilo, Panay, and a project update was provided to the ACIAR programme manager in Bolinao in April, 2008.

A further sampling period is scheduled for July 2008 in the Visayas. A project team meeting to finalise data analysis and commence writing of the final report will occur in September 2008, with expected report submission by December 2008.

4.2 Subprogram 2: Farmer-based land and water resource management for profitable and sustainable agriculture

One of the most powerful and positive forces in Philippine society is the enthusiasm of communities—including farmers—to work together for a common objective. Tapping this positive energy and enthusiasm to foster uptake of the results of research is a research subject in itself, and this project cluster pilots different approaches for extension and community engagement as well as researching the basic process. Modalities being assessed include: the landcare model (ASEM 2002/051), where the applicability of the model to agricultural production and marketing, as well as its better recognised approach as a vehicle for natural resource management, are being assessed; the Community Agriculture Technology Program (ASEM/2006/059), where new partnerships between research organisations and NGOs are being trialled; and project SMCN/2004/078, where government and farmer organisations at provincial and barangay levels in the Visayas are developing new partnerships designed to demonstrate that sustaining soil and water resources is not incompatible with improving farm-level incomes. Projects SMCN/2004/069 and SMCN/2003/006 are also testing a multi-stakeholder approach to optimising resource sustainability and farmer incomes in both southern and northern Luzon.

Projects:

Project number	Project title	Page
ASEM/2002/051	Sustaining and growing landcare systems in the Philippines and Australia	35
ASEM/2003/052	Improving financial returns to smallholder tree farmers in the Philippines	37
ASEM/2006/059	Community Agricultural Technology Program	39
SMCN/2003/006	Enhancing agricultural production in the Philippines by sustainable use of shallow groundwater	42
SMCN/2004/069	Minimising agricultural pollution to enhance water quality in Laguna de Bay (the Philippines) and Mt Lofty Ranges (Australia)	43
SMCN/2004/078	Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines	46

ASEM/2002/051: Sustaining and growing landcare systems in the Philippines and Australia

Summary

Although Landcare systems were not introduced to the Philippines as part of an ACIAR project their development and growth were a key outcome of past ACIAR-supported research. The project helped facilitate the growth of Landcare at three nodes in Mindanao (Claveria, Lantapan and Ned). More than 400 groups have been established with up to 60 per cent of farmers in each location adopting some form of conservation farming. Farmers involved in Landcare reported positive impacts on productivity and profitability. Almost 50 Local Government Units and NGOs have also become actively involved. This success has seen the approach adopted by agencies involved in development activities in Mindanao. These agencies, and others operating elsewhere in the Philippines and beyond are requesting additional information on planning, implementation and evaluation. Adopting the Landcare approach as a means of addressing rural poverty in Mindanao is now also being examined.

There are, however, questions over the sustainability of Landcare in the longer term and if the success at the three sites can be replicated elsewhere in Mindanao and beyond into the Visayas. Creating linkages to broader Landcare networks will be an aim, to help broaden the reach of the program. The role of Landcare in southeast Queensland will also be examined, following the previous project including a component examining Landcare in horticulture industries in Queensland. This revealed the spread of urbanisation in the southeast of the state was creating additional pressures for agriculture. The environmental imperatives on farmers in peri-urban areas, close to major waterways and tourism areas are growing. The effectiveness of Landcare in helping the horticulture industry in southeast Queensland to improve its viability and sustainability will also be examined. The Philippines component is improving the standard of living, social capital and environmental stewardship of poor rural communities in the southern Philippines, through:

- implementing, sustaining, and scaling-up effective landcare practices and the associated institutional structures and processes within selected vulnerable landscapes

- analysing and evaluating the appropriateness of models used to sustain and scale-up landcare processes.

Project information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation:
Queensland Department of Primary Industries and Fisheries, Centre for Subtropical Fruits, Australia

Project Leader

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Collaborating Institutions

- University of Queensland, Australia
- SEAMEO Regional Centre for Graduate Study and Research in Agriculture, Philippines
- World Agroforestry Centre, Philippines
- Catholic Relief Services, Philippines
- University of the Philippines at Los Banos, Philippines
- Landcare Foundation of the Philippines Inc, Philippines

Project Budget: \$2,016,435

Project Duration: 01/07/2004 to 30/06/2009 (Project extended from 01/07/2007 to 30/06/2009)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

Year 4 (01/07/2007 12:00:00 AM-31/05/2008)

Philippines component

The project made excellent progress during the year under review, with all but one of the eight milestones being achieved.

For Objective 1 - enabling the Landcare Foundation of the Philippines Inc (LFPI) to evolve and take on the defined roles and responsibilities for the broader development of Landcare in the Philippines - progress against milestones was as follows:

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A comprehensive two-tiered analysis of existing institutional issues for Landcare was completed and the results collated into an institutional baseline report. The analysis involved structured interviews of 48 stakeholders and four investigative workshops for LFPI Board and staff, facilitated by contracted institutional development consultants.

Using the results of the analysis through a process of two strategic planning workshops and small group discussions, a draft institutional development plan for LFPI was completed and endorsed by the LFPI Board and staff. However, while the development of a performance framework agreed by LFPI was not completed, a rudimentary framework was included in the institutional development plan and will be finalised early in the next reporting period through coordination between LFPI and the Project Leader.

The seven field staff employed by ICRAF and SEARCA were successfully transferred to LFPI under new contracts following a series of three workshops to gain agreement on roles and responsibilities, conditions of employment, site logistics and administrative procedures for the transfer.

For Objective 2 - implementing community-level Landcare activities that lead to economic growth - progress against milestones was as follows:

A regional network of three teams of Landcare Coordinators and Facilitators was established covering Northern Mindanao (Provinces of Misamis Oriental and Bukidnon), Southern Mindanao (Provinces of South Cotabato, Sultan Kudarat, and Davao del Sur) and Visayas (Province of Bohol). Through three project team workshops, a project network plan for coordinating the seven field staff across their employing agencies (ICRAF and SEARCA) and their intended employing agency (LFPI) was incrementally developed. Regional priorities were developed and implemented in line with the objective of demonstrating the role of Landcare in delivering livelihood benefits to farmers, primarily economic growth and human security.

A performance framework for monitoring and evaluating regional activities was agreed by the three regional teams and LFPI. This was facilitated through a special M&E training and development workshop in October and

subsequently refined through input from the Research Director and other senior project staff. Site teams will report progress against the framework at a special workshop in June 2008.

The detailed evaluation of the economic impacts of Landcare in the Bohol site, commenced in 2006, continued. The study has shown clear evidence of a development progression through Landcare from the initial adoption of natural vegetative strips (NVS) on degraded land to the establishment of a more diverse and commercially orientated farming system. While figures indicate a substantial increase in gross cash income in some instances, a series of case studies has been documented to describe the various land use pathways, how household access to resources influences its progression, and how various trends and shocks can inhibit or reverse the progress. The study will be completed and published by the end of 2008.

The proposed Institutional development/M&E specialist appointment to LFPI was refined to a position of "Research Manager" and the appointment completed in March.

Australian component

As a result of an eight-month delay in the completion of a social values survey of peri-urban landholders by the contractor, no significant work was completed during the period under review and the milestones of the project have been re-scheduled. The social values survey was an essential component of the baseline research data necessary to design and initiate the research process with peri-urban landholders. However, the delay not expected to significantly impact on the overall outcomes of the Australian component, although it now seems unlikely that the process with landholders will be able to be trialled at more than one site.

ASEM/2003/052: Improving financial returns to smallholder tree farmers in the Philippines

Summary

In the province of Leyte, as elsewhere in the Philippines, forest industry development is considered a priority. Economically forestry is a viable industry for many farmers, particularly if underutilised land is used. Knowledge of market demands is also needed by smallholders to better deliver in-demand products. Most of the land farmed by smallholders is marginal and sloping with few other uses. With areas of the province deforested, or at best marginally productive, forestry and agroforestry addresses a second need, positive environmental management. Pressure to log native forests, in turn increasing deforestation, can be relieved through greater smallholder involvement. Most plantings are undertaken for production forestry and conservation.

In Leyte forestry does not meet provincial demand for timber, this being met by importing logs. Smallholders and community forestry practitioners rely on timber for on-farm and household use, but less so as a supplementary income. Past ACIAR research has demonstrated greater financial returns are possible if these two groups had better market access and knowledge of prices. This would likely result in the planting of appropriate species to meet timber demand, greater volumes being produced per unit of cost and improved log size and quality. Barriers to market entry, including improved registration processes through the Department of Environment and Natural Resources also exist and will be a focal point of project activities. A strategy to improve financial returns to existing tree farmers and intending smallholder tree farmers is being implemented, to:

- assist DENR to overcome policy constraints to tree registration and log transport
- assist smallholder tree growers to satisfy market requirements and improve productivity
- identify and promote livelihood systems and policies which incorporate forestry and recognise the socio-economic circumstances of smallholders.

Project information

Overseas Collaborating Countries:
Philippines

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

Project Leader

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Collaborating Institutions

- Leyte State University, Philippines
- Department of Environment and Natural Resources, Philippines
- Southern Cross University, Australia

Project Budget: \$698,128

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

The foci of activities in the third year of the project have been to evaluate the effectiveness of the pilot schemes established in the first two years; undertake analysis of data from surveys of smallholder tree farmers and timber processors; and to further develop and distribute outputs from the project such growth and financial models, and extension materials.

During the year project researchers were active in disseminating outputs from the first two years of the project. A School-on-air Radio Program on Tree Farming Policies was presented and a CD version subsequently prepared and distributed. Extension materials (e.g. primer on tree registration, harvesting approval and log transport; booklet on tree growing; manual on tree nursery establishment) were widely distributed to smallholders, local governments and DENR staff in Leyte, Southern Leyte and Northern Samar. Various training activities were also undertaken including to 80 farmers in Claveria and Misamis Oriental through the ACIAR CATP Program. Presentation of project-related research outputs were also made in two important national forums - the

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National Agroforestry Congress and National Forestry Education Conference.

Much effort was placed in the analysis of several large data sets that have been collected as part of project activities and the preparation of journal articles and conference papers. A large number of publications have been prepared and published since January 2007, including both journal articles (18) and conference papers (23). Many of the conference papers are also in the process of being further developed and refined and will be submitted to refereed journals. The publications arising from the project during 2007 and the first part of 2008 are listed below. It is worth noting that of the 18 journal articles published, 6 were co-authored by Australian and Filipino researchers and a further 5 were authored solely by Filipino researchers. There is a similar pattern with conference publications with 16 of the 23 conference papers having at least one Australian and one Filipino author. This highlights the significant efforts placed in developing the capacity of Filipino researchers.

A highlight of the activities in 2007 was the involvement of the research team in the organisation of the IUFRO 3.08 Small-scale Forestry conference. The theme of the conference was "Improving the Triple Bottom Line Returns from Small-scale Forestry". This theme was very closely aligned to the focus of the research being undertaken as part of ASEM/2003/052. The conference attracted about 90 delegates from some 20 countries. The conference provided an excellent opportunity to showcase the research being undertaken as part of the project and to obtain critical and constructive feedback from many highly respected international scientists. Project researchers and staff presented 21 papers, of which 15 involved at least one Australian and one Filipino author. Filipino collaborators presented 13 of the 21 papers. Participation in the conference also served to focus the efforts of project researchers in writing up project results into formal conference papers covering almost all of the research undertaken through the project. Many of these conference papers are currently being refined into journal papers.

A key part of the project has been to develop the research skills of Filipino collaborators. In the initial phases of the project the focus was on developing the ability of local researchers to design and implement research projects. In the third year we have focussed our efforts on developing the data analysis, presentation and writing skills of Filipino collaborators. To this end, we have produced many jointly authored publications and the Filipino members of the research group played a prominent role in presenting papers at the IUFRO 3.08 conference.

At the end of 2007, a project extension of one year was granted. This project extension will be used to complete the analysis of the extensive data sets that have been compiled and to prepare further journal articles. In addition, we will undertake some further research into how smallholder tree farmers may be able to access developing carbon markets - which are emerging as a potentially important means of improving financial returns from tree farms.

ASEM/2006/059: Community Agricultural Technology Program

Summary

There are many challenges to the uptake of agricultural innovations in the Philippines. These vary from policy, technical and market access issues, through to communication difficulties between researchers and communities. A joint venture between ACIAR and World Vision in Thailand, Laos and Vietnam demonstrated that adoption of research results can be accelerated by providing funding for in-field facilitators, travel for researchers to visit local facilities and training local officers. This project aims to accelerate the adoption of research results from past and current ACIAR projects by farming communities. The project will provide small grants for these activities.

Project Information

Overseas Collaborating Countries: Philippines

Commissioned Organisation: International Institute for Rural Reconstruction, Philippines

Project Leader: Dr Scott Killough

Collaborating Institutions

Project Budget: \$439,683

Project Duration: 01/08/2006 to 31/12/2008 (Project extended from 01/07/2007 to 31/12/2008)

ACIAR Research Program Manager: Dr Caroline Lemerle

Project progress

Year 2 (01/08/2007-31/05/2008)

MFI

Most of MFI's farmer-beneficiaries surpassed the target of increasing corn production by 30%. Others in Argao, Cebu, have even increased their production by 80% (from 11 cavans to 20.75 cavans of corn grain). They attribute the production increase to the soil fertility management practice of utilizing cattle manure and urine.

In Argao's cattle fattening project, 32 farmers had increased their monthly income by P2,000 and 13 farmers between P3,000 to P5,000. In Buhingtubig, Pinamungajan, 16 farmers had started a cattle fattening project in April 2008. They plan to sell this in July.

The group conducted a one and a half-day Longitudinal and Cross Sectional Analysis

Workshop at Brgy. Buhingtubig, Pinamungajan, Cebu with participants coming from Lapay, Argao; Catang and Tabayag, Argao; Anopog, Pinamungajan; and Buhingtubig, Pinamungajan. Dr. Alberto Taveros, an animal science professor of Visayas State University (VSU), served as resource speaker.

MFI also conducted a one and a half-day Forage Production and Endoparasites control seminar immediately after the above mentioned workshop. Prof. Francisco Gabunada, another VSU faculty-researcher, handled this.

CASEC

Most of the CASEC farmer-beneficiaries have adopted the ACIAR technologies introduced by Dr. Taveros, specifically in the formulation of feeds and swine raising and fattening. Their current average net income in raising one pig is P1,586 (4 months production cycle) while previously, they only earn P260 (5 months production cycle). The increase in net income is attributed to low cost of feeds that they have formulated. The cost is only at P357/sack compared to commercial feeds that cost P820/sack.

CASEC has conducted pig fattening workshop, basic cross-sectional and longitudinal study, farmer to farmer reporting workshop and forage development workshop. Dr. Taveros was again tapped to conduct the pig fattening and cross-sectional and longitudinal study training while Prof. Gabunada was called to handle the forage development workshop.

PROCESS

A review on farmers' target income yielded a combined sales of goats in Owac P14,750 compared to last year's P7,000. Yanaya farmers had total sales of P6,000 last year but reported a P10,000 total sales this time. In Villa Suerte, the overall goat sales for the first 6 months of the project was only P8,000 but after another 6 months, it jumped to P14,000. A major factor for this is the improved mortality of kids due to improved goat health management practices (including endoparasite control) and improved feeds.

An Animal Health Management Training was conducted by Dr. Taveros. The training focused on ethnoveterinary medicines and practices that control the incidence of

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parasites and other diseases. Another training conducted was on Financial Analysis and Marketing Techniques. They used the baseline survey conducted during the first quarter of 2008. Using the survey results, farmers were able to assess the gains from goat sales after following Dr. Taveros' recommendations.

SWCFI

During the monitoring visit conducted by the Community Agricultural Technologies Program (CATP) Program Manager, an experimental/demo farm planted with different grass species was set-up in Bilar. The cost of the fence, which encloses the farm, was shouldered by SWCFI. The demo farm is managed by one of their beneficiaries. Most of the grasses were sourced from the Ubay Stock Farm. Some came from the Mindanao Baptist Learning Resource Center (MBLRC) and from Prof. Gabunada.

Farmer-beneficiaries in the area visited have upgraded the design of their goat houses and are practicing improved goat health management practices. Prof. Gabunada was tapped to train the farmers in goat health management and the farmers have since adopted the practice of bringing cut grasses to their goat sheds. This prevented parasites infestation which usually comes from wet grasses/plants.

ACE

Nursery sites were established in ACE's four covered municipalities namely Rosario, Laoang, Lavezares and Pambujan. These are manned by ACE's project officers and partner NGOs namely, MODE-SPPI, ACELT and BVFMC. A SEAFDEC technician is stationed for two months in Northern Samar to demonstrate nursery technology protocols. He trains project staff and sees to it that they record daily activities and monitor physico-chemical parameters particularly salinity, temperature, water depth and transparency. Dried chicken or cow manure (2 bags per pond) is hanged as tea bags to increase growth of natural food in all sites. The SEAFDEC-AQD team alternately schedules site visitations to evaluate the project's progress.

Laoang utilizes a rectangular pond measuring 500 sqm. Stocking schedule is seasonal due to zero salinity every rainy season. Pond preparation and net installation were carried out in April 2008. Final stocking is at 5,000 pcs. It grew to fly size (0.18-1.5cm) by May 7, 2008. The water management scheme is through tidal, maintained at 80-100 cm. Feeding is at

satiation (3x a day) using fish-by-catch. At 30 culture days, the stock will be harvested and counted to determine the survival rate and the pond will be prepared for the second nursery phase (another 30 DOC).

Camparangan, Pambujan utilizes an irregular shaped 300 sqm. pond area. The pond was contoured based on the mangroves natural structure. Stocking was done on Jan. 25, 2008 at 5,000 pcs (kuto kuto size (0.5-0.7 cm)). After 28 days, the operation was terminated due to zero salinity for 16 days brought about by a typhoon and continuous rain. About 750 pcs (15%) were recovered. The run was aborted and pond was prepared for restocking. On May 27, stocking of mud crab fly size (3,000 pcs) was completed. Feeding using fish-by-catch is given 3x a day at satiation and water management is done thru tidal and maintained at 80-100 cm. After 30 DOC, stocks will be sampled and harvested to determine the survival rate. Restocking will be done for the second phase.

Rosario has a pond area of 500 sqm. The pond perimeter dikes was contracted to meet the crab nursery requirement. Two weeks pond flushing was done to eradicate acid sulfates. Likewise, preparation and net fencing were completed in March 2008. Transport of mud crab kuto kuto size from San Roque and stocking were done on April 24, 2008. After two days, pond salinity was recorded at zero ppt for eight days due to flood and continuous rain. Draining or water management was not undertaken. Stock sampling and total harvest are scheduled by the end of May. If survival is high, the second nursery phase will continue. However, if survival is limited, a second run will be undertaken.

Lavezares (Bureau of Fisheries and Aquatic Resources (BFAR) pond facilities) has an ideal nursery structure for the crab project. The first phase has a total area of 500 sqm while the second phase will have 1,000 sqm. The pond is divided using fine mesh nets and bamboo structures. Intensive pond preparation was done using lime and fertilizers. Stocking was made on May 21, 2008. Daily feeding ration (3x a day) at satiation using fish-by-catch is given and water management is regularly done. The first phase of nursery culture will end June 21, 2008.

A Memorandum of Agreement was signed between ACE, BFAR and ACELT-SMMA

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that allows ACELT to utilize 1,500 sqm. of BFAR's pond for the mud crab project.

LEAF

A field site appraisal of target beneficiaries was conducted from April 17-19, 2008. Target groups are the Magdiwata Livestock Organization Landcare Group, the Tagbubungan Landcare Association and Kabuligan Landcare Association. An orientation meeting was held to orient them on the project and its objectives. A scheduled training with Prof. Gabunada was postponed due to conflict of schedule with target beneficiaries.

GATA DAKU

An orientation meeting was held among women beneficiaries of Gata Daku's micro-credit program in the municipality of Jimenez. They were oriented on CATP's objectives and project scope. They were also requested to fill-up the one-page Letter of Intent and Achievement (monitoring form) to serve as baseline data of Gata Daku and its project beneficiaries.

A coordination meeting was held with the Philippine Australian Community Assistance Project (PACAP), Provincial Government officers, Misamis Occidental Aquamarine Park (MOAP), Philippines – Australia Local Sustainability (PALS) and Misamis Occidental Aquamarine Ventures Corporation (MOAVEC). The roles of each institution and organization in the province's grouper project were discussed. It was agreed CATP will be given priority in selecting target beneficiaries and villages to be covered.

LFPI

During a monitoring visit conducted by CATP's Program Manager in their two covered barangays, namely Mat-i and Madaguing, communal nurseries full of rubber seedlings were observed. There was also a communal area for silage making using mostly corn waste as input material. MOSCAT provided the silage making technology.

SMCN/2003/006: Enhancing agricultural production in the Philippines by sustainable use of shallow groundwater

Summary

In the Philippines most low-land agriculture is in part dependent on rainfall, which is usually abundant. Rainfall also recharges lowland aquifers, which are used to supplement rainfall in irrigated cropping. This combination of rain and recharging ensures sufficient water for production. In Ilocos Norte Province there are two seasons, dry from November to April and wet from May to October. The balance between these has, to date, been enough to ensure that groundwater levels remain sustainable. There is, however, a danger of groundwater overexploitation. High-value dry season crops — mung bean, onion, garlic and other vegetables — are increasing pressure for the use of groundwater. An instance of drought or prolonged reduced rainfall could dramatically increase such pressures. Exploitation can lead to crops failing, wells drying up, loss of base-flows from water courses, saline intrusion and in severe instances land subsidence. All would also impair farmers' productivity, both in the short and also long term, creating economic and social pressures.

Currently groundwater extraction is expensive, the main reason water use has remained at sustainable levels. Extraction relies on diesel-fuelled pumps, a fuel source likely to change as electricity generation becomes more widespread. Deeper-drilling pumps and increased awareness of the benefits and returns from groundwater irrigation will also increase extraction rates. Planning and development of management options before resources such as wells, mainly controlled by individuals, reach and exceed capacity is the best way to avoid exploitation and groundwater depletion. The longer this is left the less effective it is likely to be. Exploiting shallow groundwater sustainably, based on the project's findings, will increase crop production in lowland, rain-fed agricultural areas of the Philippines.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: CSIRO
Land and Water, Australia

Project Leader

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Project Web Site:

<<http://www.clw.csiro.au/research/water/groundwater/>>

Collaborating Institutions

Bureau of Soils and Water Management,
Philippines

Project Budget: \$449,789

Project Duration: 01/07/2004 to
30/06/2009 (Project extended from
01/01/2008 to 30/06/2009)

ACIAR Research Program Manager: Dr
Gamini Keerthisinghe

Project progress

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

Annual report not yet submitted by the
project leader.

SMCN/2004/069: Minimising agricultural pollution to enhance water quality in Laguna de Bay (Philippines) and Mt Lofty Ranges (Australia)

Summary

Laguna de Bay is the Philippines largest and most important freshwater resource, being made up of three bays that form one lake. The eastern of these bays is intended to provide Metro-Manilla with water in the near future. Heavy wastewater discharge and runoff cause pollution in the western bay. The eastern bay's main water source is the Pagsanjan River, a part of the Pagsanjan-Lumban sub-catchment, most of which is used for agriculture and is increasingly a source of nutrient and pesticide pollutants. Identifying and quantifying these pollutant sources will be undertaken as part of a comprehensive biophysical and hydrological characterisation of the sub-catchment. Complementary activities will be undertaken in the Mt Lofty Ranges in Australia.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: CSIRO Land and Water, Waste and Contaminant Risk Assessment, Australia

Project Leader

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Collaborating Institutions

- University of the Philippines at Los Banos, Philippines
- Laguna Lake Development Authority, Philippines

Project Budget: \$684,796

Project Duration: 01/05/2006 to 31/10/2009
(Project extended from 01/05/2009 to 31/10/2009)

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

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

This report summarises research that was conducted during the period 1 January 2007 to 31 May 2008.

Philippines component

1. Installation of auto-samplers

Initially in January 2007, Dr. Sammy Contreras and his staff conducted a reconnaissance survey of the watershed to identify possible sites where the auto-samplers and the water level loggers could be located (Appendix 1). The four sites selected in February 2007 were chosen to represent the major landuses in the sub-catchment, namely production of rice, vegetables and coconut and piggeries since the latter is a major source of nutrients. In early February 2007 Australian staff visited the Philippines and two auto-samplers and Odyssey water level loggers were installed, with the help of the Filipino team, at Salasad (rice production) and at Lucban (vegetable production). Several weeks later Filipino staff installed the other two auto-samplers at the final two sites at Caviniti (coconut production) and at Majayjay (piggery township) (Appendix 2). Due to problems with the ownership of land at the Majayjay site this auto-sampler had to be relocated in April 2008 further down the Initian Creek near the San Francisco bridge.

There have been various problems with the auto-samplers so only water from Lucban has been collected in 2007. In April 2008 Nigel Fleming, from the Australian team, spent a week recalibrating the water level loggers, performing general maintenance on the auto-samplers and trouble-shooting any problems.

During the visit by the Australian staff in February 2007, UPLB and LLDA staff members were trained in the operation of auto-samplers, re-setting, maintenance and trouble-shooting of auto-samplers and in downloading data from the Odyssey water level loggers. Detailed written instruction sheets were also provided for the operation and trouble-shooting of the auto-samplers and the water level loggers.

LLDA staff then trained the volunteers who collected the water samples daily at each site and stored them in the fridge until collection by project staff at the end of the week for transfer to the laboratory. Details of the collection procedure were written in English and Tagalog (the Philippines national language). Details of training in

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daily water collection from the auto-samplers are given in Appendix 3.

2. Commencement of analyses

The auto-sampler at Lucban is working well and samples are composited weekly in the laboratory for pesticide and nutrient analyses while TSS samples are analysed as daily samples. The collection of samples from Caviniti started on July 30 2007, but after couple of months the auto-sampler started malfunctioning. Bridge construction has forced many of the residents to move their laundry area from downstream of the site to upstream. Due to possible effects of detergents on phosphate analyses the samples collected by the auto-sampler during the daytime (noon and 6 pm) are kept separate from those collected at night (midnight and 6 am) to determine whether detergents are having an impact on phosphate levels in the water. Sample collection at the Salasad Creek has temporarily ceased because of the construction of a bridge immediately upstream which may impact on total suspended sediment (TSS) and pesticide results. Collection was resumed in January 2008. Consequently there is little data from this site. The auto-sampler and water level loggers at Majayjay have been relocated further downstream on the Initian creek where the piggery waste flows to the San Francisco bridge.

Microbiological analyses were made of Majayjay water samples because of OHS concerns for the safety of the volunteers collecting the water samples. Appropriate protective gear has been provided for the volunteers to conduct the sampling.

Results from the survey of growers about pesticide use are given in Appendix 4. Data collected from 2007 sampling of water from Lucban are given in Appendix 5.

3. Installation of rain gauges

During the launch of the project in September 2006 several options were identified to overcome the paucity of data that was needed for the models currently used in the Philippines. A scoping document outlining how volunteers could help accumulate data, primarily TSS, rainfall and water depth measurements, for the project was produced.

It was decided that the paucity of rainfall data for the catchment could be overcome by engaging schools within the watershed in the collection of rainfall data. In early March 2007 rain gauges were installed in the nine (9) identified schools and on March 9 2007 two high school students and one teacher from

each of the schools were trained in using the rainfall gauge to measure rainfall (Appendix 6). The rainfall data are collected by Roman Corpuz, LLDA, who visits each school monthly. However, considering the distance of the rain gauge sites from the LLDA Office, the use of text messaging was proposed. Basically, the volunteers will be provided with prepaid cards regularly and then they will be asked to send through the daily rainfall data by text messaging. The collected data shall be placed in the HYMOS database established at the LLDA Calauan Office for utilisation in models. The location of the rainfall gauges and the auto samplers in the catchment is shown in Fig. 1. Examples of the rainfall data obtained so far are given in Appendix 5.

At this stage volunteers have not been trained in determining TSS and stage height measurements.

4. Ecotoxicological testing

The effect of selected pesticides, namely deltamethrin, lambda cyhalothrin and malathion, on the growth of duckweed has been evaluated across a range of concentrations. The mortality of *Tilapia* fingerlings in field collected water from Majayjay diluted at 0%, 50% and 75% has also been tested. The results from these experiments are given in Appendix 7.

Sediment toxicity tests of pesticides are planned in the future using mollusk eggs which will be collected and exposed to sediment/soil spiked with pesticides. Hatching success will be measured at designated time intervals. Possible test species are the local kuhol (*Pila luzonica*) or the golden apple snail (*Pomacea canaliculata*), which was introduced into the country and is now a pest of rice.

5. Water balance and erosion modelling and GIS mapping.

There has been very little work done yet on the water balance and erosion modelling. Some preliminary result of the application of the grid-based distributed hydrological model WinBTOPMC model in the Pagsanjan River Basin is in general very encouraging, given the limited information available, specifically on observed discharge hydrograph, the hydrological impact of site geology, and other unaccounted factors (e.g river siltation/erosion, diversion loss, etc.) (Appendix 8). To the extent that more accurate information on input spatial

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datasets, such as a detailed soil and land cover maps, and accurate discharge records become available, it is expected that the model results could be further improved.

It is planned to use the model PCARES for the erosion modelling. PCARES is a GIS-based model that has been used in the Maupali River watershed. It requires time-series rainfall data which is not available in the Pagsanjan-Lumban catchment but during the mid-term review the LLDA staff were able to obtain time-series rainfall data from an automatic rainfall gauge located in a nearby catchment, Rizal. The erosion modelling should be finished by mid 2008.

Australian Component

1. Continued analysis of water samples for sediment, nutrient and pesticides.

The three sites that have been instrumented in the Mt Lofty Ranges have received intermittent rainfall since their establishment in July 2006. No water flowed into or out of the lower dam at the grapes site until May 21 2007 and no water flowed at the cherries site until April 28 2007. The apples site is the only one that has flowed regularly but not consistently.

All water samples that have been collected have been analysed for sediments, nutrients (total N, P, C, nitrate and metals) and pesticides. A summary of the data found so far is given in Appendix 9.

2. Completion of interviews with growers about chemical use.

A total of 21 growers have been interviewed covering four main landuses in the Mt Lofty Ranges, namely the production of apples, cherries, grapes and pears. A separate assessment of the relative risk of off-site transport of pesticides has been made for each individual grower using the tool, Pesticide Impact Rating index (PIRI), and a booklet outlining the findings produced and supplied to each grower.

From the general site and chemical usage information, gathered from the broad cross-section of growers, scenarios have been developed that are representative of the conditions in the Mt Lofty Ranges and these have been run through PIRI. From the results obtained from these scenarios information sheets, called "Chemical Reference Charts", have been produced and distributed to all growers involved in the survey for feedback. Once the format has been finalised the "Chemical Reference Charts" will be distributed to growers and other interested stakeholders in the region. These sheets will allow growers to compare the relative risk of off-site transport to surface water of different chemicals in a range of environments that are representative of those in the Mt Lofty Ranges.

3. Training farmers in the use of PIRI

Many growers have expressed interest in using PIRI so a proposal was written for conducting a training program and presented to the Apple and Pear Board, South Australia. We are still awaiting on comment on the proposal and the likelihood of obtaining funding to run the training course.

SMCN/2004/078: Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines

Summary

Soil erosion and associated loss of crop productivity and degraded water resources are serious threats to agricultural livelihoods in upland areas of the Philippines. The impacts of common cropping systems on soil and water degradation and farm incomes in the Inabanga watershed were studied in project LWR/2001/003. This watershed, the largest on Bohol Island, has more than 50% of its 61,000 ha used for agriculture.

The data gathered were analysed in a GIS framework developed for the project, and this tool was used to identify areas of the Inabanga watershed at high risk of soil erosion. The researchers identified and mapped 'hotspots' - areas at highest risk of soil erosion. The project team demonstrated that cultivation of corn/cassava on steeply sloping, highly erodible soils was the major contributor to soil erosion. Corn/cassava cultivation also resulted in the lowest economic returns to the farmers and was the main contributor to siltation of the Malinao Dam.

Outcomes of the earlier project revealed that opportunities existed for farmers to reduce some of the negative aspects of agricultural activity through introduction of conservation techniques, undertaken in association with existing landcare approaches that provide training and encourage adoption.

Building on the experience and expertise developed through the earlier ACIAR projects LWR/2001/003 and ASEM/2002/051, the overall aim of the project is to promote the adoption of improved farming on highly erodible soils on steeply sloping uplands in two upper watersheds in Bohol. This will be achieved through the implementation and demonstration of erosion amelioration practices, and measurement of the environmental, economic and agronomic consequences.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: University of Western Sydney, Centre for Water and Environment Technology, Faculty of Science, Technology and Environment, Australia

Project Leader

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Collaborating Institutions

- Bureau of Soil and Water Management, Philippines
- Department of Environment and Natural Resources, Philippines
- University of Sydney, Australia
- World Agroforestry Centre, Philippines
- Applied Horticultural Research, Australia

Project Budget: \$840,299

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

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project progress

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

In previous ACIAR studies it has been demonstrated that activities which have the highest adverse impact on agricultural sustainability (and therefore long term economic sustainability) in upland farming on Bohol, include: up and down cultivation on sloping lands, continuous use of nutrient-depleting crops such as corn and cassava, and extensive cultivation of steep upland soils. These non-sustainable farming systems have been identified as those with the greatest potential for improvement to reduce soil loss and poverty. In addressing these issues, a key objective of this project is to quantify, demonstrate and provide examples to farmers of the environmental and farm-level economic benefits that can be realised by implementing selected best management practices for soil, water and crop management in affected areas.

The Project team has successfully established 3 improved practice and 3 conventional practice sites in the upper Inabanga watershed, with highly erodible soils on sloping uplands and which include a corn-cassava rotation. The sites are located in the municipalities of Carmen, Sierra Bullones and San Carlos/Pilar.

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Farmer-cooperators at the improved practice sites have been guided in implementing improved practices. Additionally, sites have been established in the upper Abatan watershed on steeply sloping land where erosion control measures have been implanted for at least 5 years and also on conventionally farmed land. The sites are in the Cadungao municipality, and had received earlier guidance in improved practices through previous ICRAF Landcare activities.

All the sites have been topographically surveyed, geo-referenced and characterised to determine site soil and water components, including physico-chemical properties, soluble and exchangeable cations, pH and nutrients. On-site weather station and automatic water flow and sampling equipment commissioning is being completed. Cropping maps and 5-year cropping schedules have been completed for the sites, with ongoing labour, planting material and fertiliser inputs recorded for all cropping activities. Additionally, crop transport and crop return revenues are recorded. Training workshops on record keeping using farm journals and farm budgeting have been conducted for farmer-cooperators, local government and Municipal Agriculture Officer (MAO) representatives. FMD teams have developed 5-year cropping plans and have been guided in appropriate land management, following initial characterisation of the farm sites.

The socio-economic team has carried out baseline and end-of-cropping-season surveys to quantify productivity of crops, input costs, marketable yields, market prices and overall economic returns on all farms within the improved and unimproved subwatershed sites. Case study data has been collected by the farmer cooperators and the Project team and is being used to guide the team in upcoming cropping periods.

4.3 Subprogram 3: Addressing regulatory, policy and technical constraints to the adoption of research outputs

Projects:

Project number	Project title	Page
ASEM/2006/091	Enhancing tree seedling supply via economic and policy changes in the Philippines nursery sector	49

ASEM/2006/091: Enhancing tree seedling supply via economic and policy changes in the Philippines nursery sector

Summary

ACIAR project scientists in the Philippines have identified within the forestry nursery sector the following major constraints to the development of smallholder and community forestry:

- the current organisation of the public and private sector nurseries is not delivering seedlings of appropriate quality to tree farmers in an equitable manner.
- there are no quality protocols in most nurseries and many potential buyers have no knowledge about the existence of nurseries which can supply planting material.
- crowding out of the private sector by public sector nurseries (including those funded with development assistance money) appears to be restricting development of the sector overall, and the role of the Department of Environment and Natural Resources (DENR) within this milieu is ambiguous.
- A study commissioned by the World Agroforestry Centre (ICRAF) supported these findings, indicating that these nursery problems are widespread in the Philippines, including Mindanao, Bohol and Cebu.

As part of another ongoing ACIAR project, strong relationships and cooperation have developed between officers of the DENR, staff of Leyte State University (LSU) and Australian researchers. This new project will build upon this close relationship to identify, develop and pilot-test policy initiatives in relation to the seedling nursery sector. Members of ICRAF will also be involved.

The project addresses a number of priorities listed in the 2006/07 ACIAR Operational Plan for the Philippines:

- Propagation systems for indigenous trees for soil and water conservation
- Market identification and utilisation of industrial trees and fast-growing agroforestry species
- Policy constraints to agroforestry development on small farms

The project aims to improve the economic efficiency and policy environment of the Philippines Tree Nursery Sector.

Project Information

Overseas Collaborating Countries:
Philippines

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

Project Leader

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Collaborating Institutions

- Leyte State University, Philippines
- World Agroforestry Centre, Philippines
- Department of Environment and Natural Resources, Philippines
- Southern Cross University, Australia

Project Budget: \$826,941

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)

The project commenced in April 2007. A focus of initial project activities was to examine the respective roles and effectiveness of the private and public sector in the tree nursery sector (Objective 1 of the project). We have described the current and public sector nursery industry and policy environment in the Philippines. We have surveyed a total of 177 nursery operators in Leyte and Mindanao including nursery operators and nursery managers from communal, government and private nurseries.

The survey involved personal interviews with respondents and assessment of the physical quality of planting stock in the nursery. Preliminary data analysis has been undertaken and published in a conference paper. We have also undertaken a comparative analysis with other SE Asian countries, including both a desktop study and visits to Indonesia, Vietnam and Thailand to look at nursery

Subprogram 3: Addressing regulatory, policy and technical constraints to the adoption of research outputs

practices and systems. The results of this investigation have helped inform other activities in the project and journal papers based on this analysis have been published in a special issue of Small-scale Forestry.

We have developed a policy assessment model and used this to identify a series of policy options to be implemented by the project at the local level in conjunction with DENR and the World Agroforestry Centre. The policy assessment model is based on a Bayesian Belief Network (BBN) and has undergone extensive validation and testing. The refined model was then used to identify key leverage points for intervention.

Stakeholders at a project workshop developed a series of potential pilot projects to be considered for implementation as part of the project. The BBN was then used to explore potential impacts of possible policy interventions and from this process the 'best bet' intervention measures were identified and pilot studies initiated. Improving *Technical Skills* was consistently a very important intervention for lifting the effectiveness of all nursery sub-sectors. *Training*, however, which directly influences *Technical Skills* in the BBN model, was found to have little influence on *Technical skills* for the individual and communal nursery sectors in particular.

Another interesting finding arising from the BBN, was that implementing interventions simultaneously, as an intervention package, is much more likely to improve nursery effectiveness than implementing a single intervention by itself.

The analysis of the ratings of potential areas for intervention by participants revealed three main themes, namely Markets, Quality of Seedlings and Funding (of nurseries). We used the model to identify a series of possible intervention measures and then refined and reduced these and developed pilot schemes in which the measures were implemented at a local level. This was achieved with extensive consultation and involvement of key stakeholders and researchers. The pilot studies are currently being implemented.

We have also commenced an economic evaluation of the private sector nurseries. We are using data from the survey of nursery operators and managers to develop benchmarks of current performance and to identify improvements in current business practices.

We have also commenced work on testing business strategies to enhance the economic viability of tree seedling nurseries. Extension materials on best nursery practices are being developed and will soon be distributed to nursery operators and extension workers.

Training of nursery operators have been carried out to enhance their skills in seedling production and improve their knowledge about the importance of seedling quality. We will conduct further training and assessments of the effectiveness of the training over the next year. Collaboration with four pilot municipalities in Leyte has been established and a Memorandum of Agreement between the project and the mayors of these municipalities were signed. The agreement emphasizes the regulation of the seedling quality from the communities of these municipalities. Controlling of seedling quality will be the responsibility of the Local Government Unit with the technical support from the project.

The project has started to draft the nursery accreditation and certification procedure, and develop criteria for certifying nurseries, which require them to apply the best practice technologies. Certified nurseries are expected to attract more sales and higher prices.

5 Projects expected to start in 2008–09

Project number	Project name
FIS/2006/126	Sandfish pond-culture in Indonesia, Philippines, Vietnam
FIS/2006/143 & FIS/2007/186	Aquaculture development in the Philippines

6 Philippines chapter from the Annual Report 2007–08

AOP budgeted expenditure in 2007–08	\$4,250,505
Actual expenditure in 2007–08	\$4,048,844
Expenditure in 2006-07	\$3,476,268
Expenditure in 2005-06	\$3,075,454

Expenditure includes both bilateral and multilateral projects

Key performance indicators	Performance 2007-08
New project investments aiming to increase income generation from aquaculture designed and implemented	A program of new projects has been implemented covering marine shellfish culture (important source of income for poor fishing families in coastal areas), sea ranching and restocking of sea cucumbers, and the potential for backyard hatcheries to profitably produce marine finfish fingerlings to meet emerging strong demand from farmers. All have a strong livelihood, income-generation focus.
Scoping study on critical policy/regulatory constraints to technology adoption completed and published	Report has been finalised and published and two follow-up activities developed as part of the new horticulture agribusiness program.
Strategy for future investment in community-based resource management/agribusiness programs developed and implemented	Strategy for agribusiness investments in the agreed sectors of horticulture and aquaculture/mariculture developed and agreed with Philippines counterparts and a major horticulture program designed and implemented. Limited budget resources led to uncertainty about the scope of future community natural resource management (NRM) programs, so this strategy development was deferred.
At least two major vegetable supply chains analysed and improvements identified and communicated	A number of southern Philippines vegetable supply chains were analysed including tomatoes, brassicas and leafy vegetables. Potential improvements to these chains were communicated to a range of stakeholders including a major NGO and a growers' co-operative. The results of this work have also now been incorporated into the major new Vegetable Value Chains program.
40 per cent of new projects to have significant farmer or policymaker impacts within five years of completion	The two major programs (fruit and vegetable agribusiness) developed during 2007–08 are designed to have significant economic impacts within five years of completion.

6.1 Position

The main aim of ACIAR's program in 2007–08 was to assist the Philippines to increase the productivity, marketability and international competitiveness for Philippine agricultural products, taking into account the impacts of trade liberalisation. A significant proportion of the Philippines' farming is carried out in fragile sloping environments or sensitive watersheds, and the program recognised that it is important that intensification of agricultural productivity does not come at the expense of degradation.

In 2007–08 ACIAR's Philippines program increasingly emphasised involvement of local partners such as local government units, non-government organisations and farmer

community groups in order to increase prospects for sustainable adoption of the results of research. Through the Community Agricultural Technologies Project and other activities, an enhanced effort was made to improve the implementation of results of earlier ACIAR-supported research in the Philippines. Linkages of regionally based delivery organisations with research organisations and policymakers based centrally in Manila and Los Baños were fostered. There was greater emphasis on the southern Philippines in the program in keeping with the directions of the broader Australian aid program.

6.2 Achievements

Subprogram 1: Increasing the market competitiveness of the Philippines' agricultural products

A: Better systems and policies for meeting market specifications

The El Niño Southern Oscillation event of 2006–07 had a significant impact in the Philippines and Australia. Although much is known in the climate science community about **the onset and impacts of ENSO events**, work was needed to bridge the gap between the knowledge in the scientific community and the application of this knowledge in decision-making. The scientists looked at the use and potential value of seasonal climate forecasts in the following case studies: corn farm-level studies in Leyte, Isabela and Bohol, a rice farm and household level study in Nueva Ecija, and a general rice policy case study in the Philippines. Other studies took place in Australia. From these case studies the researchers have started to draw together information on the potential value of seasonal climate forecasts. They are encouraged that a number of communication tools and frameworks developed in the project are already in use by groups in the Philippines and Australia.

A project to improve the economic efficiency and policy environment of **the Philippines Tree Nursery Sector** has examined respective roles and effectiveness of the private and public sector in the tree nursery sector. A policy assessment model has been developed to identify appropriate intervention points for the nursery sector at both the local and national levels. An economic evaluation of the private sector nurseries has commenced. Training nursery operators to enhance their skills in seedling production and improve their knowledge about the importance of seedling quality is underway. A Memorandum of Agreement on the regulation of seed quality has been signed with four collaborating pilot municipalities in Leyte. The work has been reinforced with the drafting of the nursery accreditation and certification procedure with certified nurseries expected to attract more sales and higher prices.

As higher temperatures associated with climate change affect rice quality around the world, researchers in the Philippines are developing DNA markers to produce more heat-tolerant varieties and **stop rice grain turning to 'chalk'**, a defect resulting in rice breaking or powdering during milling. With rice the dominant staple in

Asia and accounting for more than 40 per cent of the calorie consumption of most Asians, quality and yield losses to rice growers is a major food security issue. With a rise of just 2°C sufficient to trigger the trait, researchers noted a 4°C increase could ruin entire crops. A team at the International Rice Research Institute has redefined chalk's underlying causes and is using ACIAR funds to map newly discovered genetic variation for chalk traits onto discrete regions of the rice genome. The DNA marker can then be developed to facilitate selective breeding efforts that could deliver rice varieties less prone to chalk at high temperature.

B: Higher returns from horticultural products

The Philippines is the world's sixth largest mango-producing country, and its industry relies on **maintaining access to export markets**. However, developed economies are increasingly introducing more stringent standards for domestic consumption, and there is a greater focus on compliance with pesticide maximum residue limits (MRLs) set by each country and at the international level by the Codex Committee on Pesticide Residues. Since MRLs can vary between countries, compliance in the exporting country does not guarantee international compliance, and such disparities can result in inadvertent breaches that could lead to loss of market access. A study designed to benefit the Philippines' export industries has analysed the country's mango export chain to learn how current practices may be constraining effective residue risk management. It has also determined the capacity of the local industry to respond to the challenges of increasing scrutiny and regulatory change, outlined a potential framework to meet these challenges, and identified avenues of future research.

A project to improve **strategies for managing postharvest fungal diseases** of subtropical and tropical fruits studied how plant defence mechanisms inhibit extensive invasion of fungi during fruit development. Researchers tested treatments and worked with farmers to enhance resistance and thus suppress disease development on mangoes during

production and marketing. The team tested activators that were known resistance-inducing agents, including acibenzolar-S-methyl (Bion®) and elicitors derived from fungal pathogens (in banana). In field trials, Bion® was a consistently effective activator of resistance to anthracnose disease, when applied as a foliar spray or as a soil drench three to five times throughout the fruiting period. There is clearly potential for reducing the number of fungicides applied in a given season if Bion® is applied. Some information is available immediately to industry and has been communicated via workshops and field days.

C: Competitive and sustainable aquaculture production

A 19-day **aquaculture workshop** taught participants the principles of induced spawning of grouper using hormones. They also had the opportunity to carry out hands-on practices. The groupers spawned and although the fertilisation rate was lower than normal, participants still collected eggs and observed the development. Work on the grouper was augmented with milkfish eggs, from which they learned how to differentiate good eggs from bad and calculate fertilisation and hatching rates. They also carried out live food production from starter to mass production of live feeds, studied nursery management of grouper, and visited sites to observe occurrence of diseases in ponds and the workings of several multispecies hatcheries. In addition to this hands-on knowledge and experience, the participants gained knowledge of marine finfish aquaculture in the region through presentations by technical experts from Indonesia, Thailand and the Network of Aquaculture Centres in the Asia–Pacific region.

A study of **integrated fisheries resource management** in the Rinconada Lakes has been hampered by a sequence of significant natural disasters, the latest being floods that lasted for 30 days in February–March 2008. As a consequence the project objectives and scheduling of work tasks have been reassessed twice. Project work continues in stocking density trials and feeding experiments (including plankton sampling as an indicator of natural 'wild' food availability). Tests of water quality determined that it deteriorated significantly in Lakes Buhi and Bato during the summer months, with low levels of dissolved oxygen in surface and bottom waters the most likely cause of observed fish kills. Substantial progress was made on the water hyacinth composting objective with the design of a hyacinth chopper and conveyor system. However, the location and timing of the water hyacinth composting trials is being reviewed following the flushing of water

hyacinth from the lakes by flooding in March 2008.

Subprogram 2: Farmer-based land and water resource management for profitable and sustainable agriculture

Work on **groundwater management** has focused on two pilot sites within neighbouring municipalities of Ilocos Norte province, on the north-western tip of Luzon. At these two sites, work involves construction and calibration of groundwater models and scenario testing using these models. A techno-demo farm on water management aspects for garlic production has been established at both sites, and farmer-cooperators have learnt how to monitor soil moisture in the root zone during the cropping period. They recorded soil tensiometer readings on a daily basis, and static and pump water levels at every irrigation application. In the modelling exercise, the scenarios they simulated include the possibility of increasing the areas for garlic production during dry season cropping—assuming the current level of recharge in both basins continues. The possible effect of reduced rainfall due to drought and/or a dry spell (usually associated with El Niño phenomenon) was also studied. In the process, the number of wells and the possible expansion areas were determined so that future groundwater extraction will not exceed the rate of recharge.

In a project to **minimise agricultural pollution and thus enhance water quality** in Laguna de Bay (as well as in the Mt Lofty Ranges in Australia) the team has installed auto-samplers and water loggers to monitor quality at different sites. Philippines staff members have been trained to operate auto-samplers, including their re-setting, maintenance and trouble-shooting, and also to download data from the water level loggers. This has led to training for volunteers to collect and store the water samples prior to processing in the laboratory. Problems encountered include high levels of suspended sediment from upstream bridge construction, pesticides and phosphates (possibly arising from detergents where residents wash their laundry in the river) and piggery waste. The effect of selected pesticides on the

growth of duckweed was evaluated across a range of concentrations.

Better **herbicide use strategies and weed management options** are needed in both the Philippines' and Australian cropping. A project has worked directly with more than 40 farmer cooperators to deliver new weed and crop management practices that have significantly improved farm production and farmer returns in the short term. Adoption of the practices has been high among this group and there are encouraging signs of farmer-to-farmer transfer resulting in further adoption. The project has delivered significant outcomes for all partners: Australians have had the opportunity to study mechanisms of herbicide resistance, while PhilRice capacity in herbicide use and weed management is now stronger.

The community agricultural technology program continues to **familiarise farming communities with ACIAR-generated and new technologies** and assist Philippines researchers to work with NGOs and community-based organisations. Eight groups are active across a range of project activities including cattle and pig fattening and forage management, goat health management, mud crab and grouper aquaculture. A large range of changes in farmers' production/management practices have been made as a result of the program and a key achievement has been the empowerment of the local community to take up new technologies and generate ideas to apply the technologies to solve agricultural production problems and increase their income. The Program has close links with the successful Landcare project which brings together groups of farmers, villagers and extension specialists and provides them with the training and tools to help them manage their farms and some of the problems threatening the health of their land.

Subprogram 3: Addressing regulatory, policy and technical constraints to the adoption of research outputs

The **Landcare project** has now been extended a further two years with AusAID cofunding. The focus has broadened into three regions: northern Mindanao, southern Mindanao and the Visayas, with an enhanced commercial and economic growth focus. Project partners are strengthening the Landcare Foundation Philippines Inc. to become the institution to provide in-country leadership and coordinate future growth and sustainability of Landcare, which continues to gain farmer participation across the country and more connections with NGOs. The Landcare project will profit from

cross-linkages with a new large ACIAR project on horticulture value chains.

A project targeting **increasing the financial returns to smallholder tree farmers** in Leyte in the Philippines has continued work to generate supplementary income via better market access, agroforestry systems and knowledge of prices for smallholders and community forestry practitioners. Researchers have been active in disseminating outputs from the first two years of the project. A School-on-Air radio program on tree farming policies was presented and a CD version subsequently prepared and distributed. Extension materials (including a primer on tree registration) on harvesting approval and log transport, a booklet on tree growing, and a manual on tree nursery establishment were widely distributed. Various training activities were also undertaken, including those involving 80 farmers in Claveria and Misamis Oriental, and the presentation of project-related research outputs were also made in two important national forums: the National Agroforestry Congress and National Forestry Education Conference. The project team also organised the international 'IUFRO 3.08 Small-scale Forestry conference'.

While seasonal migration off-farm by men is leaving women in charge of farms, Asian social scientists believe the phenomenon is quietly **reweaving the social fabric of many rural communities**. ACIAR-funded collaborative research efforts are helping providers of agricultural development aid better understand the changes and provide resources, agronomic information and appropriate technologies to women as heads of households and farm managers. Farmers have responded well to efforts on the agricultural fronts with the impact of training women increasing yields by 15–20 per cent in rice-based mixed farming systems in the Philippines. The program scope has extended from the Philippines to the lower Mekong basin with similar productivity improvements. The results of the program have demonstrated the power of social science and gender research to drive farming improvements side by side with more traditional technical R&D programs.

6.3 New deal for fruit and vegetable research in the Philippines

In developing agribusiness, the Philippine Government and ACIAR have agreed to focus on the aquaculture/mariculture and horticulture sectors. The horticultural initiatives for high-value fruit and vegetable production that provide higher economic returns per unit area and that develop new export markets were designed and commenced during 2007–08. Rural areas in Leyte, Northern Mindanao (Cagayan de Oro) and Southern Mindanao (Davao) have significant potential for expanding fruit and vegetable production and quality, which could help improve the living standard of the people.

Barriers to achieving these objectives include a lack of grower expertise in soil management and crop agronomy, a high incidence of pests and diseases, under-developed markets and value chains for horticultural produce, and political/economic constraints such as limited capital/resources and insecurity of land tenure. These considerations are behind the recent development of two large multi-disciplinary ACIAR projects: 'Enhanced profitability of selected vegetable value chains in the southern Philippines' and 'Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia'.

The goal of the first project is to help lift the incomes and improve the livelihoods of growers of high-value vegetables in the southern Philippines. The program focuses on smallholder and industry profitability and market competitiveness of the southern Philippines selected vegetable industries, including potato, tomato, brassica and leafy vegetables. The research team is developing and promoting best management practices for local conditions, thus helping farmers in high-rainfall areas to produce high-value crops in the wet season when prices are high. Their work builds on foundations laid in earlier projects to tackle bacterial wilt in potatoes and tomatoes, to assess the institutional market for high-quality vegetables, improve the capacity of smallholder farmers to access these markets, and design interventions to improve the performance of value chains.

The goal of the second project is to lift economic growth in the Philippines through increased income and improved livelihoods of tropical fruit growers in the southern Philippines, targeting mango, papaya, durian and jackfruit. The research group is identifying constraints to papaya supply chains in the Philippines and determining how growers could gain increased value from the supply chains to which they belong. It also seeks to lift productivity of jackfruit in the eastern Visayas and durian in Mindanao.

The team aims to lift productivity of papaya in the southern Philippines and Australia through integrated crop management to control bacterial crown rot and *Phytophthora*-related diseases and major insect pests. Another project component focuses on sustainability of the mango industries in the southern Philippines and Australia by improving pest and disease management and ensuring consistency of supply of quality mangoes for targeted markets.

Both project teams are studying the economic impacts of new technologies and policy constraints in fruit and vegetable production in the southern Philippines and Australia. Their findings will help guide the course of further research, enhance the adoption of technologies and identify policy constraints and options for change.

6.4 Projects concluded in 2007-08

Project number	Project title	Page
HORT/2006/006	Development of an embryo culture manual and an embryo transplantation technique for coconut germplasm movement and seedling production of elite coconut types	58
HORT/2006/111	Managing trade risks arising from the use of crop protection chemicals in horticultural crops in the Philippines and Australia	60
HORT/2007/032	Detection surveys for mango seed and pulp weevils in Sarangani and Davao del Sur, Mindanao, Philippines - Phase 2	61
PLIA/2000/039	Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems	62
SMCN/2003/011	Herbicide use strategies and weed management options in Filipino and Australian cropping	64

HORT/2006/006: Development of an embryo culture manual and an embryo transplantation technique for coconut germplasm movement and seedling production of elite coconut types

Summary

World coconut (*Cocos nucifera* L.) productivity has been low for decades and nearly two-thirds of the existing palms are now too old for sustained production. Coconut farmers, mostly low-income smallholders, in more than 90 countries need high-yielding varieties which suit their local conditions. A systematic replanting program requires a good breeding program that relies on the availability of new germplasm. But the collection and movement of coconut germplasm must be undertaken using embryo culture techniques because transporting the whole fruit is impractical and also unsafe from a phytosanitary perspective.

An earlier ACIAR-funded project (HORT/1998/061) developed a new protocol of embryo culture. The new protocol is more efficient for producing robust plantlets that give a high percentage of plant establishment. The details of this embryo culture protocol need to be shared with other potential users beyond the present team, creating the need for a manual. This project developed a manuscript describing the protocol in English, Indonesian and Vietnamese, for publication and distribution as a manual through ACIAR.

The second part of the project sought to develop a reliable embryo transplantation technique as an alternative step to that of embryo culture, which is often tedious and expensive to undertake. Pioneering research undertaken during the earlier ACIAR-funded project showed that isolated embryos could be inserted into surrogate nuts and then nurtured to produce healthy seedlings, but the success rate of production was low. Studies were thus undertaken to improve this technique, using fresh locally grown coconuts in the Philippines.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: University of Queensland, Australia

Project Leader

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Collaborating Institutions

- Philippine Coconut Authority, Albay Research Center, Philippines

Project Budget: \$67,800

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

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

The information generated from the previous ACIAR project was collected and collated to produce the new embryo culture manual manuscript. This manual manuscript then underwent a series of editing steps to accommodate the views from the partners involved in the original project. The final edited version of the manual manuscript is now available for publishing by ACIAR in English, Indonesian and Vietnamese. The manual will find use in many laboratories including those of the Coconut Genetic Network (COGENT) International Coconut Gene banks which are located in the five main coconut-producing regions of the world.

The second part of the present project concerned the improvement of an embryo transplantation technique for the rapid production of seedlings of the high value coconut types. This part of the project took place at the Albay Research Center (ARC) of the Philippines Coconut Authority (PCA) and also involved the provision of some laboratory equipment and staff training at the University of Queensland.

A number of experiments were undertaken at ARC in attempt to improve the previously developed embryo transplantation technique. However, as yet no improvements have resulted in the germination of any of the transplanted nuts. This may relate to the fact that only poor quality fruit were available to do this work. Fruit quality had been significantly reduced by a series of severe typhoons hitting the region during the course of this work. Work is now under way to improve the technique using higher quality fruit.

Concluded projects

The main impacts of the project have been for the Filipino project partner (ARC). The capacity of their centre to undertake coconut research has increased, enabling the present work to continue on, with some small amount of national support after the present project finished. There is now an opportunity for the centre to take the outcomes of the project, particularly those to do with embryo culture, to the next stage of development and maybe commercialisation.

A pilot study is now needed to scale-up the approach, particularly to cater for the high-value coconuts such as the aromatic types Kopyor and Makapuno. At the same time the capacity of the partner country would be significantly improved if a genetic pool of these types of coconut could be established there. The centre could then exhibit to private investors and coconut farmers the commercial potential of the technique. This pilot project would increase the likelihood of the present project (and other previously ACIAR-funded projects) having a higher impact and for that impact to be realised more quickly.

HORT/2006/111: Managing trade risks arising from the use of crop protection chemicals in horticultural crops in the Philippines and Australia

Summary

The Philippines is the world's sixth largest mango-producing country, and as an exporter it relies on maintaining access to markets to sustain economic viability and development. Japan, a significant export market for the Philippines, recently implemented a new 'positive list' MRL (maximum residue limit) system, i.e., a detectable pesticide must have a MRL set domestically as a government standard and at the international level by the Codex Committee on Pesticide Residues. Increasing levels of residue monitoring have led to a reported five-fold increase in MRL breaches for food commodities imported into Japan (e.g. in 2005 there were a total of 72 breaches detected, but by 2006 the number had climbed to over 110 for the first quarter following the launch of the new MRL system). The focus of this project was to assess the capacity of the Philippine mango industry to respond to the challenges posed by the increasing scrutiny and regulatory change in export markets. This involved assessments of analytical and technical capacity and a residue risk assessment (i.e., gap analysis with regard to standards in importing countries). Other tasks included an evaluation of current regulatory mechanisms with respect to gaining pesticide access, a review of current pest management systems, an examination of current quality control procedures and an attempt to identify what linkages currently exist between the various sectors.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: AKC Consulting Pty Ltd, Australia

Project Leader

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Collaborating Institutions

- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Crops Research Division, Philippines
- University of the Philippines at Los Banos, National Crop Protection Center, Philippines

Project Budget: \$80,025

Project Duration: 31/05/2007 to 01/06/2008

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

When food commodities are traded between countries these foods are understood to be safe for human consumption and any residues in or on the traded food must comply with the importing countries' or the Codex limit. Unfortunately, as MRLs can vary between countries, compliance in the exporting country does not guarantee international compliance. These MRL disparities can result in inadvertent breaches occurring, with potentially significant consequences e.g., loss of market access. This can have serious implications for both the grower and the exporter in the developing country.

With the above matters in mind, this study was carried out with the aim of benefiting export industries in the Philippines. The project team analysed the mango export chain in the Philippines, assessing how current practices may be constraining effective residue risk management. It also focused on the capacity of the local industry to respond to the challenges posed by increasing scrutiny and regulatory change. This final report outlines a potential framework for the development of strategies to meet these challenges, and identifies how future research could be targeted to address constraints.

HORT/2007/032: Detection surveys for mango seed and pulp weevils in Sarangani and Davao del Sur, Mindanao, Philippines - Phase 2

Summary

The reported presence of Mango Seed Weevil in the Philippines prevents mango fruit from this country accessing lucrative export markets including the United States and Australia. This small activity was a six-month detection survey for mango seed and pulp weevils in the province of Sarangani. It initiated sampling on Samal Island and also maintained a low level monitoring program in Davao del Sur in Mindanao, Philippines, continuing from ACIAR-funded project *Detection surveys for mango seed and pulp weevils in Sarangani and Davao del Sur, Mindanao, Philippines* (HORT2007/210). The broad objective of this project was to increase profitability of mango-growing enterprises at all levels by expanding the areas of mango production certified as being free from seed and pulp weevils, thereby increasing the export opportunities and value of Philippine mango fruit.

Project information

Overseas Collaborating Countries: Philippines

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

Project Leader

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Collaborating Institutions

- Bureau of Plant Industry, Philippines
- Office of the Provincial Agriculturist, Philippines

Project Budget: \$98,000

Project Duration: 01/07/2007 to 29/02/2008
(Project extended from 01/01/2008 to 29/02/2008)

ACIAR Research Program Manager: Mr Les Baxter

Project outcomes

The team undertook detection surveys for mango seed and pulp weevils, commencing in March 2007 and ended in February 2008. The presence of seed weevil in the Philippines is

disputed while pulp weevil is only confirmed from the island of Palawan in western Philippines. These intensive surveys aimed to demonstrate the current status of both pests in Sarangani and Samal Island as well as demonstrating ongoing area freedom in Davao del Sur. These three provinces contain important mango-producing areas with significant export potential.

The project received the full support of the Provincial Local Government units (LGU) who pledged logistics assistance as required. During the survey, eight mango fruits from each of 10,600 and 2,015 individual bearing trees were collected and processed from Sarangani and Samal Island respectively. Furthermore, mangoes from 2,894 trees were processed in the ongoing detection survey in Davao del Sur.

Trees and fruit were randomly selected, fruits were cut open and the flesh and seed visually inspected for presence of weevils and/or symptoms. At the same time fruit were assessed for damage from other insect pests to provide data on significant insect activity. This information will be useful in a current ACIAR-funded project to improve mango pest management and postharvest handling for mango in the Philippines.

These results showed no evidence of any stage of seed or pulp weevil in 84,800, 16,120 and 23,152 sample fruits from Sarangani and Samal Island and from Davao del Sur respectively.

The project also supported research into the district-wide distribution of mango seed weevil in north Queensland commercial and domestic mango trees during 2006–07 as well as studies to develop practical field control strategies.

The project demonstrated that neither mango pulp nor seed weevils were present in the provinces surveyed and these data can be used to assist Philippine Quarantine to access export markets via area freedom certification. Many export markets are currently closed to the Philippines due to the uncertain status of these two mango pests of Quarantine importance.

PLIA/2000/039: Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems

Summary

Migration from farms, either to seek off-farm employment as an income supplement or to move to areas for greater opportunities is common throughout much of Asia. Off-farm employment is seen as a way to boost income, particularly for smallholder family-owned farms. This may increase income but at the cost of reduced farm labour and the likely consequence of reduced farm productivity. Increasing economic pressures from trade liberalisation, globalisation and their impacts, together with environmental constraints such as disease and weed pests and water availability, are increasing trends to migrate and/or to work off-farm.

The wider these pressures and their affects are felt, the greater the probability of reduced farm productivity impacting on the broader economy. It is men who increasingly migrate to seek off-farm employment. This is leading to far-reaching changes to household structures and, in cases of long-term or permanent migration, economic and social changes. Women are increasingly being left with the task of farm management, including having to overcome production constraints, mainly from lost labour inputs of husbands, brothers and other male workers.

Such changes are also occurring in some farming communities in Australia, creating many of the same issues. Little research has been done regarding these changes, their impacts and farm management. Of particular interest are technologies that can be used to alleviate production constraints caused by labour shortages, to help women in Asian and Australian farming systems to manage farms.

The overall goal of this project was to better understand the changes occurring in rural agriculture in Asia and Australia in relation to the changing role of women as a result of off-farm employment and/or migration. It also investigated the differences in constraints and needs between male and female household heads. In particular, the project identified possible strategies and technologies to help women household heads to better manage farms.

Project information

Overseas Collaborating Countries:
Philippines, Thailand, Vietnam

Commissioned Organisation:
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Philippines

Project Leader

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Collaborating Institutions

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- Khon Kaen University, Thailand
- Cuu Long Rice Research Institute, Vietnam

Project Budget: \$496,764

Project Duration: 01/01/2004 to 31/03/2008 (Project extended from 01/07/2007 to 31/03/2008)

ACIAR Research Program Manager: Dr Jeff Davis

Project outcomes

The project focus in Asia was on migration, which was defined as the move or change in residence of family members of farming households, leaving other family members behind. In Australia, the focus was on off-farm and/or nonfarm work. A rapid rural appraisal (RRA) and census of farming households in 48 villages in Thailand (northeast), 46 in the Philippines (Central Luzon and Bicol regions) and 42 in Vietnam (North and South) revealed that migration is occurring in both rainfed and irrigated ecosystems. However, migration is higher in rainfed villages than in irrigated villages. Migration is highest in northeast Thailand – 63% of farming households in rainfed and 54% in irrigated villages have at least one migrant. Migration is lower in the Philippines and Vietnam (about a quarter of farming households). In Western Australia, approximately 77% of farming families undertake off-farm and/or nonfarm work. This involves either one or more family members working part-time or full-time (but still helping on the farm).

Surveys of farming households with and without migrants were conducted in rainfed and irrigated villages in Thailand (830), the Philippines (813), and Vietnam (831). Results showed that, among the male migrants in Thailand and the Philippines, more sons than principal males/heads of household migrate, leaving elderly parents to manage the farms. This is in contrast to Vietnam, particularly in the north, where more principal males/heads of households than sons leave the villages for employment, leaving principal females/wives with more responsibilities on the farm aside from their household and child care responsibilities. The 'push' factors of rural migration are poverty, low income from rice, small landholdings, lack of jobs, low wages in the villages, and other natural calamities such as drought, floods, avian flu, pig disease etc., which affect farm production.

Remittance earnings and nonfarm income comprised a larger share than farm income of the total household income in the Philippines, Thailand and North Vietnam. The share of remittance earnings to household income ranged from 28% (domestic migration) to 65% (international migration) in the Philippines, 30 to 49% in Thailand, 21 to 35% in South Vietnam, and 46 to 48% in North Vietnam. Nonfarm sources contributed 14–26% in Thailand, 19–28% in the Philippines, 8–10% in South Vietnam, and 10–17% in North Vietnam to total annual household income. However, in South Vietnam, rice income comprises about 39–57%, which was higher than the share of remittances.

Families left behind spent their remittance income on food and daily expenditures, children's education, farm inputs, house repair/construction, and debt payments. Thus, migration is an escape from poverty and a part of livelihood strategy. But the survey found that families left behind still maintained rice yields on a par with those households without migrants, despite the reduction in family labour supply.

However, male migration has a greater effect on gender roles and women's empowerment. Men traditionally dominate in decisions related to farm operations and crop management,

while women are custodians of household cash and dominate in household decisions. In Thailand, where more sons and daughters are the migrants, the labour participation of principal females did not change. In the Philippines, labour participation of principal females declined as they were more engaged in nonfarm activities. In cases in which the principal males left, the principal females took over the management of farms. However, in Vietnam, principal females took over in traditional tasks of men such as irrigating the fields, spraying chemicals, and hauling and marketing of farm products.

Women have less access to agricultural training and extension activities, new seeds, and technologies (labour saving and cost reducing) that can reduce their work burden and increase the returns of their labour. Several strategies and technologies validated through participatory action research focused on enhancing women's knowledge and skills in all aspects of rice production. Rice technologies were disseminated through participatory experiments by men and women, the use of extension materials, real samples of pests, and news broadcasts through village loudspeakers as well as participation of local agricultural extension units. In Australia, participants of the Women's Rural Leadership Program were trained to run a farm as a business.

The next generation of farmers who are better educated no longer find rice farming a satisfactory source of income and they will continue to seek greener pastures. The elderly parents and the women will be left behind to sustain household food security. The challenge is how to upgrade farming from subsistence to commercial farming using the latest advances in science and technology generated by international and national agricultural research institutions. There is a need to enhance the skills of family members (particularly the women) left behind so they are equipped with the knowledge required for modern farming.

SMCN/2003/011: Herbicide use strategies and weed management options in Filipino and Australian cropping

Summary

Weeds in the Philippines' rice sector are increasingly being managed by the use of herbicides, introduced as farmers move away from traditional approaches where seedlings are grown then transplanted into paddies. Almost half (44%) of all rice is now grown by direct seeding, driven by a range of economic and environmental factors, but the main drawback to this system is weeds and their control. Water availability is a key issue in selecting the method of growing – the less water available, the greater the imperative to direct seed. At the same time labour costs have risen, and they are a key input in transplanting rice (which requires 50% more labour). By contrast herbicide costs, a key input into direct seeding, have fallen.

Experience in other countries shows that, if not properly managed, herbicide use can lead to resistance in weeds. Once resistance is established herbicide options can quickly become limited, making direct seeding all but impossible. Acting during the early stages of resistance build-up is the best option to stop it reaching uncontrollable levels.

Project Information

Overseas Collaborating Countries:
Philippines

Commissioned Organisation: University of Western Australia, Australia

Project Leader

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Collaborating Institutions

- Philippine Rice Research Institute, Philippines
- CSIRO Sustainable Ecosystems, Australia

Project Budget: \$512,041

Project Duration: 01/07/2004 to 30/06/2008

ACIAR Research Program Manager: Dr Gamini Keerthisinghe

Project outcomes

The project worked with a significant number (40+) of direct farmer cooperators and delivered important new weed and crop management practices that significantly improved farm production and farmer returns in the short term. Adoption of the practices has been high amongst farmer cooperators and there are encouraging signs of farmer-to-farmer transfer, resulting in further adoption.

The project has delivered significant outcomes for both the Australian and Filipino partners. Australian researchers have benefited from the opportunity to further study mechanisms of herbicide resistance, while PhilRice capacity has been strengthened in key areas. Two PhDs have been initiated through the project, and the project partners have delivered an impressive suite of publications.

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

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

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

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

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

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

2007-15 [PLIA/2006/012 Part 2]	<i>Cattle and buffalo in Cambodia and Laos: the economic and policy environment for smallholders.</i> Matthew Harding, Derek Quirke, Robert Warner, 2007, 98 pp. http://www.aciar.gov.au/node/5196
2007-16 [ASEM/2001/037]	<i>Improving the marketing system for fresh produce of the highlands of PNG.</i> John Spriggs and Barbara Chambers, 2007, 67 pp. http://www.aciar.gov.au/node/8457
2008-01 [AH/2006/163]	<i>Assessment of zoonotic diseases in Indonesia.</i> Nigel Perkins, Ian Patrick, Mahomed Patel and Stan Fenwick, 2008, 100 pp. http://www.aciar.gov.au/node/6987
2008-02 [LWR/2005/042]	<i>Scoping study to assess the technical and economic feasibility of wheat production in southern Bangladesh.</i> P. Carberry, M. Saifuzzaman, H.M. Rawson, M.A. Sufian, A.B.S. Hossain, N.P. Dalgliesh, 2008, 44 pp. http://www.aciar.gov.au/node/7189
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2008-04 [AH/2005/107]	<i>Food safety research in Indonesia: a scoping study and ACIAR's response.</i> Roger Morris and ACIAR, 2008, 67 pp. http://www.aciar.gov.au/node/7097
2008-05 [LWR/2000/089]	<i>Permanent beds for irrigated rice-wheat and alternative cropping systems in north-west India and south-east Australia.</i> Liz Humphreys, Geoff Beecher, Yadvinder Singh, S.S. Kukal, H.S. Sidhu, Jagadish Timsina, John Blackwell, David Smith, Rajinder Pal Singh, 2008, 69 pp. http://www.aciar.gov.au/node/7190
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2008-08 [FST/2006/118]	<i>An inventory of wild sandalwood stocks in Vanuatu.</i> David Gillieson, Tony Page and Jeffrey Silverman, 2008, 56 pp. http://www.aciar.gov.au/node/8439
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2008-10 [AH/2006/077]	<i>Identifying research priorities for the development for the beef industry in Cambodia and Lao PDR with special reference to animal health interventions.</i> Peter Windsor, Suon Sothoeun and Syseng Khounsey, 2008, 11 pp. http://www.aciar.gov.au/node/8474
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2008-12 [LWR/2005/059]	<i>Modelling water and solute processes and scenarios for optimisation of permanent raised bed systems in China, India, Pakistan and Indonesia.</i> Freeman J. Cook, John H. Knight, Elizabeth Humphreys, Judy Tisdall, JackMcHugh, Greg Hamilton, 2008, 105 pp. http://www.aciar.gov.au/node/8491
2008-13 [SMAR/2007/197 – Part 1]	<i>The potential for cashews in eastern Indonesia</i> Ian Baker, Julian Witjaksono, 2008, 16 pp. http://www.aciar.gov.au/node/8508
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2008-15 [SMAR/2007/197 – Part 3]	<i>The potential for mangosteen in eastern Indonesia</i> Ian Baker, Muji Rahayu, Herman Suheri, Mursal, 2008, 16 pp. http://www.aciar.gov.au/node/8510
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2008-17 [SMAR/2007/197 – Part 5]	<i>The potential for rambutan in eastern Indonesia</i> Clive Jones, Made Susastika, Fatuchri Sukadi, Arif Surahman, 2008, 23 pp. http://www.aciar.gov.au/node/8512

2008-18 [SMAR/2007/228a Indonesian]	<i>Studi kelayakan: Meningkatkan pembesaran dan nutrisi lobster di Nusa Tenggara Barat.</i> Clive Jones, Made Susastika, Fatuchri Sukadi, Arif Surahman, 2008, 23 pp. http://www.aciar.gov.au/node/8537
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2008-25 [CP/2006/113]	<i>Scoping study to investigate the role of women in the safe production, promotion and utilisation of indigenous vegetables.</i> Virginia Brunton, 2008, 23 pp, http://www.aciar.gov.au/node/8851
2008-26 [HORT/2006/108]	<i>The potential for tropical fruits production in Tonga: a feasibility and constraints analysis.</i> Patricia Chay, Yan Diczbalis, Victor O'Keefe, Rod Strahan, Viliami Kami, Lamipeti Havea, Tevita Tapaevatu and Alipate Tavo, 2008, 86 pp. http://www.aciar.gov.au/node/8866
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2008-35 [LWR/2006/076]	<i>Agricultural water-use efficiency in north-west China.</i> Philip Young, David Marston, Wang Jinxia and Li Xiande, 2008, 80 pp. http://www.aciar.gov.au/node/9015

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1	<i>Financial and economic research methods</i> . Steve Harrison and John Herbohn, 2008, 86 pp. http://www.aciar.gov.au/node/7333
2	<i>Research planning and management for foresters</i> . Michael Blyth, 2008, 62 pp. http://www.aciar.gov.au/node/7330
3	<i>Communicating science</i> . Paul Holford, Janne Malfroy, Paul Parker, Patricia Robinson, Wesley Ward and Patricia Kailola, 2008, 47 pp. http://www.aciar.gov.au/node/7331
4	<i>Social and community dimensions to ACIAR projects</i> . Digby Race and Joanne Millar, 2008, 33 pp. http://www.aciar.gov.au/node/7332

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	<i>ACIAR Annual Report 2006–07</i> . October 2007
	<i>Working with ACIAR now and in the future: ACIAR's response to the results of a survey of international stakeholders</i> . December 2007
	<i>ACIAR Annual Operation Plan 2008–09</i> . June 2008
	<i>Adoption of ACIAR project outputs: studies of projects completed in 2003–2004</i> . David Pearce and Jeff Davis (eds), 2008, 87 pp.
	<i>Country profiles:</i> China (November 2007) Cambodia, Lao PDR, Thailand (November 2007) Indonesia (November 2007) Pacific islands (November 2007) Papua New Guinea (November 2007) Philippines (November 2007) South Asia (November 2007) Vietnam (November 2007)
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