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Australian Centre for International Agricultural Research

Adoption of ACIAR project outputs

2016

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The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. ACIAR operates as part of Australia's international development cooperation program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

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ACIAR ADOPTION STUDIES

ACIAR seeks to ensure that the outputs of the research it funds are adopted by farmers, policymakers, quarantine officers and other beneficiaries. As part of its efforts to monitor the outputs and outcomes of its projects, ACIAR commissions project leaders and participants to revisit projects 3–4 years after completion, and report back to ACIAR on the medium-term outcomes of the work. This series reports the results of these studies. Numbers in this series are distributed internationally to selected individuals and scientific institutions, and are also available from ACIAR's website at <aciar.gov.au>.

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Cover: [left] Robynson Kali, a wholesaler who supplies fresh produce weekly to Pogera Gold Mines in Enga province with his family and workers, Kindeng, Jiwaka province (Photo: Christie Chang); [top right] Shu Fukai and Phetmanyseng Xangsayasane in direct seeded RD15 rice field (Photo: Mr Tui).; [bottom right] Study team measuring soil moisture profiles at San Isidro, Bohol. (Photo: J Bavor)

Foreword

As part of its ongoing evaluation process, the Australian Centre for International Agricultural Research (ACIAR) periodically revisits a sample of past projects some time after their completion and critically appraises their outcomes. ACIAR commissions an appraisal of large projects 3 or 4 years after they are completed, to determine the level of uptake of the project outputs and gauge the extent of the projects' legacies. The appraisers study the outputs under three broad categories: the emergence of new technologies or practical approaches to tackling problems; the gaining of new knowledge that would lead to better understanding of scientific and socioeconomic aspects of agriculture; and the introduction of new models and frameworks to assist policymakers in reaching decisions that influence the environment of farmers and others along the market chain.

This report, the 13th in our series of adoption studies, documents the adoption results for five ACIAR projects completed in 2011–12. They involved five partner countries: Papua New Guinea (PNG), Indonesia, the Philippines, Lao People's Democratic Republic (Lao PDR) and India.

Three of the projects involved food- and crop-related issues: sweetpotato, rice, and mixed production of corn, cassava, rice and vegetables. One project focused on improving veterinary service delivery in Indonesia. And the fifth project involved improved watershed management in Andhra Pradesh, India.

Sweetpotato, the main staple crop in PNG, has the potential to deliver more to everyone along the production and marketing chain. A project to gain greater understanding of the constraints in the sector has led to the linking of participant farmers to a microcredit scheme and provided them with financial training. Researchers are also now better equipped to guide the adoption of new processing technology.

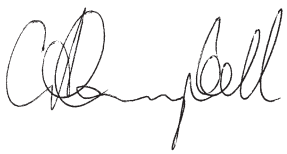
On the island of Bohol in the Philippines, where the farmland is subject to massive erosion, farmers are learning through demonstration sites and field schools how to manage their sloping sites. This project highlighted the benefits of using well-managed traditional extension and dissemination to introduce and sustain good farming practices.

Likewise, in Lao PDR, the researchers found that the best adoption took place when they interacted with farmer groups rather than with individuals. They were impressed by the interaction between traditional farmer knowledge and the newly introduced methods, leading to modified but successful outcomes that diverged from those originally envisaged.

In Indonesia, where serious diseases such as anthrax, rabies and brucellosis are regularly transmitted from animals to humans, an ACIAR project has helped that country to combat the diseases through greater vigilance and improved response to outbreaks. It is gratifying to note the gains in local research capacity through postgraduate training, workshops and study tours.

ACIAR has been involved for the long haul in helping to improve the management of watersheds in Andhra Pradesh, where farmers practise rainfed dryland agriculture. Management at the institutional level is paramount, and the latest project in this region has seen a lift in the capacity of government agencies, and encouragement of postgraduate and student investigators. This has led to a sharpened focus on watershed development projects at the official level.

In their discussion of some of the barriers to adoption, the authors note the common constraints of conservatism, low skill levels, illiteracy and lack of finance among the farmer clients. This is a reality check and a reminder that we must not put our own expectations of ready uptake upon communities who work within a different world view.



Professor Andrew Campbell
Chief Executive Officer, ACIAR

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AIP-EID	Australia–Indonesia Partnership for Emerging Infectious Diseases
DGLAHS	Directorate General of Livestock and Animal Health Services (Indonesia)
DRD	Department of Rural Development (India)
FFS	Farmer Field School
FPDA	Fresh Produce Development Agency (Papua New Guinea)
GIS	geographic information system
ICRAF	World Agroforestry Centre (formerly International Council for Research in Agroforestry)
IWMP	Integrated Watershed Management Program (India)
Lao PDR	Lao People's Democratic Republic
LGU	local government unit
MNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme (India)
PNG	Papua New Guinea
WSD	watershed development

Overview

DAVID PEARCE AND ANDREW ALFORD

Introduction

This report summarises the adoption results for five Australian Centre for International Agricultural Research (ACIAR) projects completed in 2011–12. The projects involved:

- five individual partner countries—Papua New Guinea (PNG), Indonesia, the Philippines, Lao People's Democratic Republic (Lao PDR) and India
- three crop-related projects—sweetpotato; rice; and mixed production of corn, cassava, rice and vegetables
- one livestock-related project (in Indonesia) focusing on enhancing veterinary service systems
- one watershed development policy project (in India).

The outputs from the projects were diverse, ranging from a comprehensive evaluation of institutional arrangements to ensure success of watershed development projects (in India) to identification and release of rice varieties (in Lao PDR). The projects covered in this report reflected a balance of technology, policy and knowledge outputs.

Most of the projects also involved capacity building in partner countries and institutions, ranging from formal university-based training to a variety of on-the-job training activities for technical staff, research scientists and farmers.

The five adoption studies indicate medium to high levels of adoption of the project results. In each case, the adoption results provide some useful lessons and observations.

What was discovered–project outputs

ACIAR's adoption studies classify outputs into three broad categories:

- **new technologies or practical approaches** for dealing with particular problems or issues, which are designed to be applied ultimately at the farm, processing or marketing level, or in some cases at the breeder level
- **new scientific knowledge or basic understanding** (pure or basic science) of the phenomena or social institutions that affect agriculture, which are designed as inputs into further research processes, ultimately to help in the future development of practical approaches for smallholders, processors, wholesalers and retailers
- **knowledge, models and frameworks for policymakers** or broad-level decision-makers, which are not necessarily for use at the farm level but will influence the contextual environment in which farmers, processors, wholesalers and retailers must operate.

Given the diversity of ACIAR-funded research, there is considerable overlap between these categories, and many projects contribute to more than one of them. Table 1 summarises the the outputs for the five projects covered in this report.

New technologies or practical approaches were the major outputs of four of the projects. These were mostly targeted at the farm level.

New technologies and approaches at the farm level included:

- improved farmer financial training
- delivery of best-practice management for soil and water in the Philippines
- release of new rice varieties in Lao PDR.

In addition, one project involve practical approaches in veterinary systems (Indonesia).

New scientific knowledge—in particular, social science and economic knowledge—was an important output from one of the projects. This involved understanding of sweetpotato value chains (PNG).

Four projects also developed **knowledge or models relevant to policymakers**. These were recommendations for improving smallholder access to microfinance (in PNG), policy recommendations for improving veterinary services (in Indonesia), geographic information system (GIS) rainfall maps (in Lao PDR) and recommendations for watershed development projects (in India).

Table 1 Summary of project outputs

Project	New technologies or practical approaches	Scientific knowledge	Knowledge or models for policy and policymakers
Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea	Linking of farmers to National Development Bank microcredit scheme Financial literacy training	Description of sweetpotato value chain and economic analysis of gross margins. Understanding of factors constraining adoption of processing technology	Recommendations for improving smallholder access to microfinance Recommendations for improving sweetpotato marketing systems in PNG
Improving veterinary service delivery in a decentralised Indonesia	A range of specific approaches for better control of zoonotic diseases in Indonesia (including anthrax, rabies and brucellosis)		Recommendations for policy reform and institutional strengthening to improve operation and coordination of Indonesia's veterinary service systems, including developing INDOVETPLAN in preparedness for response to outbreaks of transboundary and zoonotic animal diseases
Evaluation and adoption of improved farming practices for soil and water resources, Bohol Island, the Philippines	Best management practices for soil, water and crop management in shallow, sloping landscapes, including plastic mulch, trickle irrigation, hybrid varieties and vegetative strips. These were delivered through farmer-managed demonstration sites and Farmer Field Schools Introduction to farmers of private-sector technology transfer through a commercial seed company		

continued ...

Table 1. (continued)

Project	New technologies or practical approaches	Scientific knowledge	Knowledge or models for policy and policymakers
Increased productivity and profitability of rice-based lowland cropping systems in Lao PDR	Release of three adapted rice varieties (including provision of seed to 400 farmers in 20 villages) Direct-seeding technology package Agronomic package for maize and legumes in rotation with rice		GIS maps of rainfed lowland rice environment of Savannakhet and Champassak
Enhancing institutional performance in watershed management in Andhra Pradesh, India			Empirical information on the institutional arrangements to allow effective implementation of watershed development projects

GIS = geographic information system; Lao PDR = Lao People's Democratic Republic; PNG = Papua New Guinea

Capacity development

Most of the projects reported here had explicit or secondary objectives to improve the capacity for research and development in partner countries. Table 2 summarises the capacity built and used in the projects.

Capacity development included both formal training (university-level degrees), and on-the-job and informal training. Training ranged from advanced topics, such as choice modelling and the use of reverse auctions, to improvements in extension skills and traditional laboratory training.

In most cases, the research capacity and research infrastructure continue to be used after the project is complete. The collaboration developed between organisations often remains in place, and staff skills and expertise developed through training continue to be used.

Table 2 Research capacity built by the projects and its continued use

Project	Research capacity built in partner country(ies)	Research infrastructure	Capacity used
Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea	Training of PhD student and 2 postgraduates Training of team members in questionnaires and interviews Study tour to Australia for 3 research scientists	Data loggers and associated software Incubator for disease identification	Research scientists and extension officers trained to apply the knowledge and skills acquired to other projects
Improving veterinary service delivery in a decentralised Indonesia	Substantive capacity building through postgraduate training (including 16 Masters degrees and 2 PhDs), workshops and study tours		Considerable use of capacity developed. Individuals trained continue to use knowledge in their roles, and many have received promotions as a consequence
Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines	Training in agronomy using farmer-managed demonstration site and Farmer Field School Establishment of partnerships with local government units		Farmer-managed demonstration site and Farmer Field School continue to be used as training centres
Increased productivity and profitability of rice-based lowland cropping systems in Lao PDR	Limited capacity development through GIS aspects of the project and focus-groups approach		
Enhancing institutional performance in watershed management in Andhra Pradesh, India	Capacity in the government agencies involved, as well as through PhD students and student field investigators		Continued use of capacity as a result of considerable ongoing interest in watershed development projects at the official level

Uptake of the research and development outputs–progress along adoption pathways

Most of the projects had a number of different objectives and outputs. Summarising the often complex adoption outcomes for a range of projects is difficult and involves an element of judgement. For the summary in Table 3, a four-level classification scheme has been used (as in previous adoption reports).

In this classification scheme, the lowest level of adoption is *0*, or no uptake of the results by either initial or final users of the outputs of the project. One project had no adoption of some of the project outputs (although there was low to medium adoption of other project outputs).

The next level of adoption is *N*, in which there has been some uptake by initial users but not by final or ultimate users of the research. Three projects had some outputs in this category (although other components had higher levels of adoption).

The next level of adoption is *Nf*, in which there has been uptake by initial users and some uptake by ultimate users. Three projects had at least some outputs in this category.

The highest level of adoption, *NF* (use by initial and final users), was achieved in all five projects (for at least some of the components of the projects).

Factors contributing to the adoption of project outputs

Many factors always underlie particular adoption outcomes. They can be summarised as follows:

- Knowledge
  - Do the final or ultimate users *know* about the project outputs?
  - Is there *continuity* of staff in organisations associated with adoption, leading to the ongoing transfer of knowledge?
  - Are the outputs *complex* compared with the capacity of users to absorb them? (Do users have a sufficient knowledge base to support adoption?)
- Incentives
  - Do users have sufficient *incentives* to adopt the outputs?
  - Does adoption of the outputs increase *risk or uncertainty* for the users, thus reducing incentives to adopt?
  - Is adoption either *compulsory* or indirectly *prohibited*? (Are there extreme forms of incentives or barriers?)
- Barriers
  - Do potential users face *capital or infrastructure constraints*, limiting their ability to fund the adoption of the outputs?
  - Do potential users face *cultural or social barriers* to adoption?

Table 3 Current levels of adoption of key project outputs

Project	New technology/ practical approach	Scientific knowledge	Knowledge, models for policy
Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea	*Nf*—financial literacy training adopted by Fresh Produce Development Agency *NF*—more farmers groups linked to microcredit by a participating farmer leader, and opening personal savings accounts	*N*—extension officers adopting value-chain approach	*NF*—more farmers selling to local buyers, leading to emergence of a wholesaling sector
Improving veterinary service delivery in a decentralised Indonesia	*NF*—control of anthrax and rabies in Bali		*NF*—INDOVETPLAN framework *NF*—a range of specific policy recommendations
Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines	*N*—core improved farming practices		
Increased productivity and profitability of rice-based lowland cropping systems in Lao PDR	*NF*—new rice varieties *NF*—direct seeding *Nf*—non-rice crops		*NF*—GIS mapping framework
Enhancing institutional performance in watershed management in Andhra Pradesh, India			*NF*—particularly immediately after completion of the project *N*—subsequently in some regional aspects

GIS = geographic information system

Note: Level of uptake is summarised as high, medium, low or none using the following abbreviations:

NF Demonstrated and considerable use of results by the initial and final users

Nf Demonstrated and considerable use of results by the initial users but only minimal uptake by the final users

N Some use of results by the initial users but no uptake by the final users

O No uptake by either initial or final users.

Table 4 summarises some of the major factors affecting adoption for the projects reported here.

Relatively high levels of adoption of some outputs appear to have been driven by strong economic incentives, such as improved production and incomes.

Relatively low levels of adoption of other outputs resulted from different factors, including lack of incentives in the marketing chain, changes in policies relating to particular products, and risk aversion.

Table 4 Factors influencing adoption and impact–summary of key findings

Factor		Key findings
Knowledge	Do potential users know about the outputs?	This was not identified as an issue in these projects.
	Is there continuity of staff in organisations associated with adoption?	For the veterinary program in Indonesia, continued employment and promotion of staff involved in the project meant that these staff became users of the project outputs, substantially contributing to adoption.
	Are outputs complex in comparison with the capability of users?	Conservatism and illiteracy were identified as constraints to adoption in PNG. On Bohol Island in the Philippines, very low skill levels of farmers limit their ability to adopt some project outputs. The 'simple' nature of adopting a new rice variety led to very high adoption in the rice project in Lao PDR. In contrast, adoption of direct-seeding technologies in the same regions is considerably more complex, resulting in slower adoption profiles.
Incentives	Are there sufficient incentives to adopt the outputs?	In Lao PDR, new technologies and varieties that are labour saving generate a significant incentive for adoption. In PNG, selling and buying of sweetpotato by bags, and the absence of explicit grades or standards (and hence price premiums) provide no economic incentive for farmers to improve postharvest practices (especially sorting and grading).
	Does adoption increase risk or uncertainty?	This was not identified as an issue in these projects.
	Is adoption compulsory or effectively prohibited?	This was not identified as an issue in these projects.
Barriers	Do potential users face capital or infrastructure constraints?	On Bohol Island in the Philippines, famers face financial contraints to the purchase of basic cropping inputs (including hybrid seed). Constraints on the delivery of key inputs also limited adoption. In PNG, adoption of alternative packaging methods for sweetpotato was limited by the additional costs that such approaches incur, despite the potential improvement in quality on delivery to the market.
	Are there cultural or social barriers to adoption?	In the PNG sweetpotato project, the run-down state of the PNG agricultural extension system and 'wantokism'—that is, sharing of information and technical know-how only with close friends and relatives—were important constraints to widespread adoption.

Lao PDR = Lao People's Democratic Republic; PNG = Papua New Guinea

Lessons

The results from the adoption studies reported here provide a number of lessons for ACIAR-funded projects.

Benefits can come through indirect means

The veterinary project in Indonesia was very successful because it responded directly to the expressed needs of Indonesian partner agencies. To a degree, this involved work in areas that would not be considered traditional agricultural research, particulary dealing with rabies. However, effective work in dealing with rabies on the island of Flores, and subsequently Bali, created strong incentives for the Governemnt of Indonesia to modernise its animal disease preparedness and response systems. This, in turn, has wider benefits for agriculture, as well as benefits for Australia through improved biosecurity.

Similarly, the PNG sweetpotato project found that participatory action research was a useful approach for identifying and addressing issues of priority to farmers, and going beyond research to generate actual impacts. Providing financial literacy training and linking farmers to microcredit to improve access to credit, which was identified as important by farmers rather than researchers, is another case that illustrates the benefits that can come from indirect means.

Traditional extension still works

The project on Bohol Island in the Philippines clearly illustrates that traditional extension and dissemination of good farming practices remain capable of delivering benefits, and that continuing to find effective means of training farmers yields benefits.

Dynamics of adoption are important

The rice project in Lao PDR illustrated an interesting point about the dynamics of adoption. In Lao PDR, there is regular exchange of seed between farmers within the same village, but very limited seed exchange across villages. Overall adoption can be maximised by providing a small quantity of seed to a large number of villages (rather than a large amount of seed to fewer villages).

Research is more effective with groups of farmers

Experience in the Lao PDR project indicated that research appears to be more effective when groups of farmers are involved, rather than researchers interacting with individual farmers in isolation. Farmer-to-farmer communications in group situations produce more generally applicable outputs. This leads to much higher adoption, particularly when more complex change is required. Farmer-to-farmer interaction appears most effective in combining old and new knowledge to make a technology work in the specific local context. Indeed, the final application of the technology can look quite different from what the researcher first envisaged.

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

ASSOCIATE PROFESSOR CHRISTIE CHANG, INSTITUTE FOR RURAL FUTURES, UNIVERSITY OF NEW ENGLAND

Project number	ASEM/2006/035
Project title	Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea
Collaborating institutions	Australia: University of Canberra, New South Wales Department of Primary Industries Papua New Guinea (PNG): National Agricultural Research Institute, Fresh Produce Development Agency, Rural Women's Development Initiative
Project leaders	Australia: Associate Professor Christie Chang PNG: Mr Robert Lutulele, Dr Birte Komolong
Project duration	1 January 2008 to 30 September 2011
Funding	$1,507,791 total (ACIAR contribution $977,878)
Countries involved	Australia and PNG
Commodities involved	Sweetpotato
Related projects	• ASEM/2001/037: Improving the marketing system for fresh produce of the highlands of PNG • SMCN/2003/010: Farmer evaluation and multiplication of sweetpotato varieties on the North Coast of PNG • SMCN/2005/043: Analysis of biophysical and socioeconomic constraints to soil fertility management in the PNG Highlands • CP/2004/071: Management of pests and diseases of sweetpotato in Papua New Guinea • ASEM/2005/044: Towards a research agenda for improving consumer demand and marketing of sweetpotato in PNG • ASEM/2005/126: Report on ACIAR Sweetpotato Workshop in Madang

1 Motivation for the project and what it aimed to achieve

Sweetpotato is the major staple food in Papua New Guinea (PNG), and an important source of income for subsistence farmers in the PNG Highlands selling marketable surpluses in the local market. A farmer survey conducted in Jiwaka Province in 2012 showed that 25% of the average annual household income of K5200 came from selling sweetpotato, followed by livestock and poultry (23%), coffee (18%), fruit and vegetables (14%), trade store (9%) and others (11%). The study also showed that, on average for the households surveyed, 61% of total sweetpotato produced was sold for cash, 23% was for home consumption and 14% was used for animal feed.

In recent years, marketing opportunities for PNG Highland sweetpotato have emerged in coastal cities such as Lae and Port Moresby. Many farmers have ventured into long-distance marketing, lured by high prices. However, long-distance marketing of sweetpotato from the PNG Highlands (mainly Eastern Highlands Province, Western Highlands Province and Jiwaka Province) to coastal markets faces high product losses and marketing costs, mainly as a result of poor packaging and postharvest handling, inadequate marketing infrastructure, and poor roads and an unreliable transport system.

The aim of this project was to increase financial returns to smallholder farmers and other participants in the PNG sweetpotato value chain. This was to be achieved by improving the quality of the product, and reducing marketing costs through the adoption of improved postharvest and marketing practices.

ACIAR has invested substantially in research in the sweetpotato sector in PNG, because it is the most important food crop for most PNG people and is becoming a major source of income for rural households. Most of these projects have focused on on-farm production, including variety evaluation (SMCN/2003/010), soil fertility management (SMCN/2005/043), and pest and disease management (CP/2004/071). However, it was argued strongly in the scoping study (ASEM/2005/044: *Towards a research agenda for improving consumer demand and marketing of sweetpotato in PNG*) that on-farm production and productivity improvements alone are not sufficient to improve farm income. This is because of the inelasticity of demand for sweetpotato, with respect to changes in price and income.

This project focused on improving marketing efficiency and postharvest management, and was therefore complementary to the other, primarily production-oriented, ACIAR sweetpotato projects. Other aspects that set this project apart were the focus on female farmers (because of their involvement in sweetpotato marketing) and the participatory action research approach that was used. This approach enabled the project team to work with farmers and other value-chain players, not only to identify issues but also to find solutions to these issues.

The project team was interdisciplinary and involved five collaborating organisations: the University of Canberra (the commissioned organisation) and NSW Department of Primary Industries from Australia; and the Fresh Produce Development Agency (FPDA), National Agricultural Research Institute and Rural Women's Development Initiative from PNG. These research organisations came together because of their common interest and expertise in improving sweetpotato marketing, postharvest management and value adding, as well as their extensive experience in working with ACIAR.

2 Outputs–what the research project produced

The project began with a detailed mapping of the social, economic and technical components of the PNG sweetpotato supply chains. Whereas the social and economic components focused on relational, institutional and cost issues, the technical component focused on issues related to postharvest management and value adding. Supply-chain mapping was carried out through a series of stakeholder consultations from farm to market, market analysis and consignment trials.

The results indicated that there were serious concerns regarding packaging (bags too big), postharvest handling (high product losses), transport infrastructure (high costs, poor roads and no specialised transport system), and supply-chain coordination (no collaboration or communication between potential partners). For women, there were gender-specific issues relating to personal safety, poor market facilities, and inequality in division of labour and distribution of income within the household.

After priority issues were identified by stakeholders, technical issues were addressed through packaging trials, a curing trial, disease identification to find locally appropriate methods to reduce produce losses, and an exploration of options for sweetpotato processing. Socioeconomic issues were addressed by providing financial literacy training, linking farmers to financial institutions to improve their access to credit, finding ways to consolidate sweetpotato bags and link farmers to transporters and buyers, and providing training in marketing and financial literacy to improve women's participation in sweetpotato marketing. Major outputs included the following.

Technical

- Successful application of the participatory action research approach, which brought researchers and stakeholders together, and fostered collaboration between partner organisations.
- A detailed description of sweetpotato value chains and a SWOT (strengths, weaknesses, opportunites, threats) analysis of the PNG sweetpotato sector.
- Economic analyses of gross margins for selling sweetpotato to different markets, and prices, including seasonality, price trends and linkages in four major sweetpotato markets.
- Sales volume assessment in the Lae market.
- A case study of best-practice sweetpotato marketing.
- Identification of critical control points and alternative packaging materials for reducing product losses.
- Better understanding of the factors constraining adoption of sweetpotato processing technology.
- Successful linkage of farmers to the National Development Bank's microcredit scheme.
- The opening of mobile savings accounts with Bank South Pacific.
- Extension materials (DVDs, booklets, fact sheets and posters) on postharvest management for extension officers to use and distribute to farmers.

Policy

- Policy recommendations for improving access to microfinance for smallholder farmers.
- Policy recommendations for improving sweetpotato market information systems in PNG.

Capacity built

- One PhD and two postgraduates.
- Improved capacity of female farmers in marketing and financial literacy.
- Improved capacity of PNG junior researchers in design and conduct of consignment trials, disease survey and identification, data collection and analysis, conduct of surveys, report writing, Powerpoint presentations, and workshop facilitation.
- Improved capacity of team leaders in project management, and preparation of high-quality technical reports and research proposals.
- Improved capacity of FPDA extension staff in providing training in gross margin analysis, financial literacy and marketing planning.
- Raised awareness and improved understanding among farmers and traders of the factors affecting price, cost, profit and product quality, and of ways to reduce costs, and improve farm income and financial returns.

Robynson Kali, a wholesaler who supplies fresh produce weekly to Pogera Gold Mines in Enga province with his family and workers, Kindeng, Jiwaka province (Photo: Christie Chang)

3 Adoption–how the project outputs are being used

Technical outputs were disseminated to extension personnel, farmers and local governments through various means, including a *Kaukau* (sweetpotato in the local language) Fair (the first of its kind in PNG), five stakeholder workshops, training workshops, extension materials, and FPDA and National Agricultural Research Institute newsletters. Their adoption led to the following results:

- Better trained junior staff have been able to apply their improved research skills to other projects when given the opportunity.
- The FPDA has adopted and incorporated financial literacy training and gross margin analysis into its Village Extension Workers training program, which previously focused mainly on farm production. These new skills have also been applied to other projects, including ACIAR projects on improving women's business acumen.
- The National Development Bank's microcredit scheme has gained widespread recognition throughout Jiwaka Province, and is accessed by many farming communities.
- As a result of financial literacy training, more than 200 farmers in six communities have opened savings accounts with Bank South Pacific and added to their balances, providing financial security, and helping to reduce vulnerability to poor harvest results and family emergencies. This number is increasing via word of mouth.
- More farmers are now selling to local traders, rather than travelling long distances to Lae or Port Moresby on their own.
- Extension officers have adopted the value-chain approach and have become more market oriented, as well as more aware of their expanded role in linking farmers to market and service providers, in addition to improving farm production.

Factors affecting adoption of technical outputs *positively* included:

- identification of target communities, and lead farmers and community leaders in those communities
- simplicity of the extension materials
- monitoring and facilitation by local project staff and extension personnel.

Factors affecting adoption of technical outputs *negatively* included:

- the rapid turnover of project staff, extension personnel and lead farmers
- 'wantokism'—that is, sharing of information and technical know-how only with close friends and relatives
- low levels of education and cognitive capacity of most farmers, with regard to understanding new concepts.

4 Impact–the difference the project has made or is expected to make

The project has contributed to several improvements and changes in the local communities, including:

- increased household income and improved livelihood for smallholder farmers, due to
  - improved access to credit and better money management skills, which have enabled farmers to save money for investment in their children's education and better housing
  - better postharvest handling practices, enabling farmers to attract customers and sell at a premium
  - an improved understanding of the relationship between prices, costs and returns that encouraged farmers to sell to local traders. This is an alternative to individual farmers venturing to coastal markets themselves with small numbers of bags—it saved time and money, and saved female farmers from harassment and attack en route to the market
- reduced income risk, and vulnerability to food insecurity and family emergencies, as a result of money being safely tucked away in savings accounts
- improved social status of female farmers in the household and community, because they were contributing more to household income, church activities and social obligations
- empowerment of women, because of the knowledge and skills acquired, and their ability to make better informed decisions, both personal and business related.

Agnes Merep, former village extension worker of FPDA and President of the South Wahgi Organic Farmers Association, with her nephews whom she is encouraging to do farming, Gusamp Village, South Wahgi, Jiwaka (Photo: Christie Chang)

Community impact might have been more substantial if the marketing infrastructure to the Port Moresby market were more reliable. Community impact would also be greater if the demand for fresh produce could be maintained after the construction phase of the PNG Liquefied Natural Gas Development Project.

The main lessons from this adoption study were as follows:

- Although the focus of this project was on sweetpotato, better understanding of costs and returns, and recommended postharvest and marketing practices was applicable for all other farming activities. This adoption study found that the new knowledge and technology promoted in the project were used for commodities other than sweetpotato because of relative profitability, in most cases. Given that the majority of smallholder farmers operate a diverse farming enterprise, future research projects would yield better outcomes if they were whole-farm based and interdisciplinary, rather than being commodity and single-issue based.
- Participatory action research is a useful approach, not only for going beyond research to making changes and impacts on the ground, but also for addressing issues that are of priority to farmers, rather than researchers. It also lends support to, and operationalises, the paradigm of agricultural research for development (AR4D)—a useful focus for ACIAR projects.
- Because most farmers had low levels of literacy and had not been exposed to new ideas, continuing monitoring and facilitation by local staff was essential to maintain the momentum of change.

ACIAR AH/2006/166 Improving veterinary service delivery in a decentralised Indonesia

HONORARY ASSOCIATE PROFESSOR HELEN SCOTT-ORR, FACULTY OF VETERINARY SCIENCE, UNIVERSITY OF SYDNEY

Project number	AH/2006/166
Project title	Improving veterinary service delivery in a decentralised Indonesia
Collaborating institutions	Australia: New South Wales Department of Primary Industries Indonesia: Directorate General of Livestock and Animal Health Services, Provincial Livestock Services for Bali and East and West Nusa Tenggara, Disease Investigation Centre Denpasar, Gadjah Mada University, Bogor Agricultural University, Udayana University
Project leaders	Dr Helen Scott-Orr Dr Anak Agung Gde Putra Drh Noeri Widowati
Project duration	February 2008 to June 2012
Funding	$1,910,781 total (ACIAR contribution $1,547,079)
Countries involved	Indonesia
Commodities involved	Livestock and livestock products
Related projects	None

1 Motivation for the project and what it aimed to achieve

The problem

In 2006, ACIAR was asked by the Government of Indonesia to create a project to assist Indonesia in preparedness for, response to, and control of, severe transboundary and zoonotic animal diseases. This followed several instances of disease incursions or spread, including:

- classical swine fever in Sumatra in the 1990s, which spread across Indonesia to Papua by the mid-2000s
- rabies in eastern Flores in 1997, which spread to western Flores by 2004
- highly pathogenic avian influenza, which entered Indonesia in 2003, spread widely and became a national epidemic, and threatened to become a global pandemic.

Indonesia's traditional centralised approach to disease control had been compromised by the introduction of regional autonomy (otonomi daerah) since the 1990s, and a new approach was required.

(L-R) Drh Sri Widjayanti, former Head of Surveillance section DGLAHS; Drh Elly Sawitri, FAO consultant; Drh Noeri Widowati, DGLAHS; Dr Pudjiatmoko, former Director of Animal Health, DGLAHS; Dr Helen Scott-Orr, former Australian Project Leader; Dr James McGrane, FAO-ECTAD Leader; Drh Ison Idris, Epidemiology staff, DGLAHS. (Photo: H Scott-Orr)

Partnering

The project scoping study and design drew on longstanding cooperative relationships between the Indonesian Directorate General of Livestock Services; the Animal Disease Research Institute at Bogor (Balitvet); the Disease Investigation Centre Denpasar; the Provincial Livestock Services for Bali, West Nusa Tenggara (Nusa Tenggara Barat) and East Nusa Tenggara (Nusa Tenggara Timur); and the New South Wales Department of Primary Industries (formerly NSW Agriculture). Key senior staff in these organisations had worked together in the Australian-funded Eastern Islands Veterinary Services Project (EIVSP) in phase I from 1989 to 1993, and then phase II from 1994 to 1998. Excellent long-term outcomes from EIVSP had been recognised, and the Government of Indonesia requested a project to build on these outcomes.

Objectives

The project aimed to:

- improve Indonesia's emergency animal disease preparedness and response systems
- improve effectiveness and efficiency of three (later four) endemic disease control programs in eastern Indonesia—anthrax in Nusa Tenggara, rabies in Flores (and later in Bali), and brucellosis in West Timor
- communicate learnings on new service delivery models to Indonesian and donor agencies.

2 Outputs–what the research project produced

The project produced a series of reports, policy and technical documents. It provided conclusions and recommendations to all layers of government—and to related projects and donor organisations—about improvements needed across a wide range of systems. These documents emerged from annual or more frequent central or regional workshops, from three Australian study tours looking at key aspects of animal health and production in Australia, from a series of specific training programs, and from local postgraduate research studies carried out in association with this project. Many of the recommendations recognised that policy reform and institutional strengthening are never finished, and suggested ways that specific issues might be progressed by other projects, or by ACIAR and/or other agencies.

In particular, insights from this project helped to shape parts of two key related programs: the Australia–Indonesia Partnership for Emerging Infectious Diseases (AIP-EID) program, implemented by the Australian Government Department of Agriculture, Fisheries and Forestry (now the Department of Agriculture and Water Resources) from 2011 to 2015; and the rabies component of the Emergency Centre for Transboundary Animal Diseases Indonesian program of the Food and Agriculture Organization of the United Nations (FAO-ECTAD program), 2011–14.

Specific technical documents produced under the project included 'Anthrax in Nusa Tenggara' and 'Standard diagnostic techniques for rabies in Indonesia', both published in Indonesian by the Directorate General of Livestock and Animal Health Services (DGLAHS), as well as a training manual in incident control systems. The project made major inputs into roadmaps for improved rabies control in both Bali and Flores.

Capacity building by this project was arguably its greatest output, and was very significant for the large numbers of people who were involved in workshops, study tours, training programs and postgraduate programs. Activities under the INDOVETPLAN systemic improvement objective developed understanding, in people at all levels of the animal health system, of more efficient ways to coordinate animal health delivery in a complex environment, and to operate in the face of emergency diseases. Research activities associated with specific disease control pilot programs enabled local scientists to develop a deeper understanding of specific technical and socioeconomic issues, so that they could implement improved programs in the target areas and in other parts of the country. Involvement of local university and research co-supervisors of these scientists has also strengthened long-term veterinary higher education.

Several groups of people were key beneficiaries of the project's capacity building, namely:

- veterinarians who completed local postgraduate studies (16 Masters degrees and 2 PhDs) researching animal disease control programs under the project, and their university supervisors from three Indonesian veterinary faculties
- numerous Indonesian government veterinary and other officials at central, regional, provincial and district levels, who attended project workshops and training programs centrally or in the target provinces, and participated in Australian study tours
- Australian, other expatriate and Indonesian staff of related donor organisations and projects, who were helped by the project learnings to focus their assistance, and develop and implement related projects
- Indonesian university and government staff involved in the early stages of the Indonesian Veterinary Leadership program.

3 Adoption–how the project outputs are being used

Since 2011, adoption of project policy, technical and capacity outputs has been very high, considering their complexity and breadth of scope.

Policy outputs and recommendations regarding improvements to Indonesia's emergency animal disease management system have been progressed very significantly by the DGLAHS, especially by the many Indonesians who were directly involved in the project, and by related donor programs (next users), in close partnership with the DGLAHS and provincial governments. Notably, the project was the catalyst for some of the key changes that were later implemented through the AIP-EID program. This program was a key next user of project recommendations, which helped the final users in the DGLAHS and the provinces to strengthen their systems.

Comments from people involved in the project included the following:

> The Australian study tour showed me the weakness of our system and the need for change. This project was a wake-up call showing the hazards and the need for greater system improvement. The AIP-EIP program is now making this a reality by strengthening our system step by step. (Drh Tjahjani Widiastuti, Head of the Exotic Animal Disease Preparedness subdirectorate, Directorate of Animal Health, Indonesian Ministry of Agriculture—participant on Australian study tour)

> We have a dream—we want to educate our field officers on the emergency management system, choosing high-risk areas (e.g. borders, and high-population areas like Java). (Drh Yurike Elisadewi Ratnasari, Head of Emergency Preparedness Section, Masters student with the project)

The AIP-EID program, now in its second phase, has made huge strides in systemic improvement of emergency animal disease preparedness and response, including:

- drafting appropriate subordinate legislation and engaging other relevant ministries for a 'whole-of-government' preparedness and response framework
- developing a comprehensive 'Manual on emergency management system: guidelines on establishing an operational emergency management system for emergency animal disease preparedness and response'
- revising Indonesia's 'Foot-and-mouth disease national preparedness and response strategy'
- conducting a number of simulation exercises for emergency disease incursions and producing a guideline on how to conduct such exercises
- carrying out wide-ranging training of Rapid Response Teams for different provinces
- successfully progressing the Indonesian Veterinary Leadership program.

The FAO-ECTAD program applied comprehensive program management processes to assist the Bali and Nusa Tenggara Timur provincial governments to control rabies. This included undertaking several annual rounds of dog vaccination, and increasing public awareness of rabies in Bali and Flores, building on implementation of the project's incident control systems pilot, integrated surveillance and information management, and dog ecology studies.

Comments from people involved in the project included the following:

> Rabies is endemic in several parts of Indonesia. Bali had been rabies free until the disease was first confirmed in humans and in dogs in November 2008. FAO developed a program of three rabies projects with the DGLAHS, funded through the FAO Indonesia country program, AusAID [the Australian aid program] and USAID [United States Agency for International Development]. The objectives of the Bali rabies control program were to control rabies using a One Health approach, targeting control in dogs and case management in humans through collaborative, cross-sectoral and multidisciplinary mechanisms, progressing towards eventual elimination of the disease.
>
> The successful implementation of four mass dog vaccination campaigns in 2010–13 has resulted in an impressive reduction in human rabies cases, with just one human case reported in 2013; a substantial reduction in dog cases has also occurred, with only 40 cases recorded in 2013, compared with 120 in 2012. A new rabies project funded by WSPA [World Animal Protection], to support control and elimination of the disease in Flores and Lembata Islands, NTT [Nusa Tenggara Timur] Province, was agreed and signed by the DGLAHS in November 2013, and activities are now under way. (FAO-ECTAD 2013 annual report)

Based on intensified experience of rabies control in Flores and Bali, the DGLAHS and the National Animal Health Commission, supported by the AIP-EID program, have prepared a 'Masterplan of rabies control and eradication in Indonesia'.

Technical outputs related to better control of key zoonotic diseases have been applied in the original pilot areas, and in some cases more widely in different parts of Indonesia. In particular, outputs include the following:

- Targeted anthrax vaccination in Nusa Tenggara based on information gathered and published by the project has reduced anthrax incidence there to almost zero in the past 2 years.
- The techniques detailed in 'Standard diagnostic procedures for rabies in Indonesia' are being applied across the country, including a simplified system for straw sampling of animal brains, which has made rabies diagnosis and surveillance safer and more cost-effective.
- Use of risk analysis to guide prevention of spread of both rabies and brucellosis in Indonesia has arguably helped to maintain some areas free from each disease. In particular, the province of Nusa Tenggara Barat (Lombok and Sumbawa islands) has implemented risk-based surveillance and public awareness measures for rabies prevention, and so far remains free from rabies. More recently, similar public awareness activities have begun in Papua Province.
- There has been continued work by the Indonesian Quarantine Agency with district animal health authorities to prevent any spread of brucellosis from West Timor to other uninfected parts of Nusa Tenggara Timur or beyond.
- The extra risks to Australia from spread of rabies in Indonesia, highlighted by the findings of the project to Australian authorities since 2010, have led to intensified surveillance and public awareness activities in northern Australia, Papua New Guinea, Timor-Leste and eastern Indonesia, through both the Northern Australia Quarantine Strategy and ACIAR-funded research conducted by the University of Sydney.

Capacity-building outputs, in the form of better educated and more motivated government veterinarians, are being well used. This is shown by the promotions since the project finished of two-thirds of the postgraduates who received project scholarships, and the use of their skills and capacities to implement more effective and efficient disease control programs.

Many of the current senior DGLAHS staff, including the Director of Animal Health, were involved in project workshops and activities, and the project gave them a wider perspective on changes needed to improve system effectiveness.

The former Project Research Coordinator, Dr Agung Putra, continues to play a leading role in training and motivating participants in the Indonesian animal health system, as well as helping to draft legislative changes, promote better rabies control and encourage publication of project results.

The adoption and progression of the Indonesian Veterinary Leadership program by the AIP-EID program is resulting in the training and personal development of a growing number of government veterinarians at junior, and increasingly senior, levels.

4 Impact–the difference the project has made or is expected to make

The clearest impacts of the project to date have been in improving people's health by reducing the incidence of key zoonotic diseases, especially anthrax and rabies. Greater efficiency and effectiveness in the delivery of animal disease control programs also provide economic impacts for livestock owners, and their families and communities, and the governments who fund the control programs and provide health services.

The longer-term impact of improved Indonesian emergency animal disease preparedness and response systems can only be beneficial. Preventing or rapidly combating new incursions of serious transboundary and zoonotic diseases provides great potential savings to Indonesia, in the form of avoidance of economic and social costs of animal and human deaths and illness.

In addition, improved Indonesian emergency animal disease preparedness, surveillance and response systems act as something of an insurance policy for Australia, in helping to mitigate the risk of biosecurity threats entering Australia.

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

ADJUNCT PROFESSOR JOHN BAVOR, SCHOOL OF SCIENCE AND HEALTH, WESTERN SYDNEY UNIVERSITY

Project number	LWR/2004/078
Project title	Evaluation and adoption of improved farming practices on soil and water resources, Bohol Island, the Philippines
Collaborating institutions	Australia: University of Western Sydney (UWS), Water Research Laboratory; Applied Horticultural Research Philippines: Bureau of Soils and Water Management (BSWM), International Centre for Research in Agroforestry; Department of Environment and Natural Resources
Project leaders	Australia: Professor John Bavor (UWS) Philippines: Dr Rogelio Conception (BSWM)
Project duration	1 January 2007 to 31 December 2010; 1 January 2011 to 31 December 2011
Funding	$1,292,708 total (ACIAR contribution $866,751)
Countries involved	Australia, Philippines
Commodities involved	Corn, cassava, rice, vegetables, fruit
Related projects	LWR/2001/003

1 Motivation for the project and what it aimed to achieve

Soil erosion, associated loss of crop productivity and degraded water resources are serious threats to agricultural livelihoods in upland areas of the Philippines. Soil erosion is particularly important in the Central Visayas region of the Philippines, as a result of high, seasonally concentrated rainfall, steep slopes and highly erodible soils.

The impacts of common, traditional cropping systems on soil and water degradation, and farm incomes in the Inabanga watershed were studied in project LWR/2001/003 (2002–06). The main cropping systems that were identified and studied were agroforestry, woodland, oil palm, corn/cassava, grassland, irrigated rice and rainfed rice. Key environmental and socioeconomic effects of these land-use systems were determined. Corn/cassava cropping on steeply sloping, highly erodible soils was determined to be a major contributor to soil erosion and also resulted in the lowest economic returns to the farmers.

The project was initiated following an external review of the earlier project (LWR/2001/003). ACIAR continued its focus on Bohol with the implementation of a new project in 2007. The project, reported here, built on the soil erosion, hydrologic and financial lessons from the previous project, and joined forces with community-based implementation activities funded by ACIAR and other agencies. The project was developed after discussions and close consultation with the Philippine agencies Bureau of Soils and Water Management, World Agroforestry Centre (ICRAF), and Department of Environment and Natural Resources. It built on the experience and expertise developed through the earlier ACIAR projects LWR/2001/003 and ASEM/2002/051.

Key objectives of the project were to demonstrate, quantify, 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 shallow, sloping landscapes.

2 Outputs–what the research project produced

The project introduced, and provided training in, improved farming practices within two major watersheds on Bohol. The improved techniques implemented were:

- use of plastic mulch
- use of trickle irrigation (where feasible)
- planting of F1 hybrid vegetable varieties selected to suit the climatic and market requirements
- undertaking Farmer Field School (FFS) training in agronomy, provided by the project staff and later incorporating farmer–cooperator trainers
- use of natural vegetative strips in combination with planting of cash crops within the hedgerows
- improved crop nutrition management.

An important output was the introduction to the farmer community of private-sector 'technology transfer' resources, which were used to promote improved farming practices at a locally adoptable scale. A commercial company, East-West Seed, Philippines, assisted the project team in a number of initial agronomy management

training sessions in which hybrid vegetable seed and plastic mulching techniques were demonstrated and taken up by the farmers. These techniques were subsequently adopted and locally modified by the project farmer trainers in ongoing training and workshop sessions.

Additionally, pest and disease management was an important issue for farmers throughout the project. The FFSs provided by East-West Seed and the project staff significantly improved the pest and disease diagnostic skills of farmers working on the improved project sites. Appropriate pesticide and crop scheduling options were presented for specific crops. In all cases, after FFS participation, the level of pest and disease control improved significantly.

The project has strengthened skills in using new tools to monitor and collect needed data. A new technique that has been introduced is the use of specialised capacitance-based soil moisture array systems.

A significant capacity development outcome of the project has been the establishment of a collaborative partnership with local government units (LGUs), through the municipal agriculture office, ICRAF and East-West Seed, for the implementation of FFSs on high-value crop vegetable production using improved technologies. The LGUs have provided some initial inputs through loans to farmers, using a microfinancing/honour repayment approach. Additionally, East-West Seed has provided appropriate production technology strategies and basic training in farm accounting to help farmers determine whether the technology is a positive or negative contributor to their income.

With the assistance of the municipal agriculture office, the project facilitated the drafting and approval of an ordinance that designates the project research sites as official Municipal Learning Centres for soil and water conservation, and improved farming practices. The drafted ordinance has encouraged more farmers, agricultural technicians, students, politicians and other interested groups to visit the area and learn about different dynamics for the improvement of their farms. It has also provided information on the development of long-term planning options for sustainable agricultural development at municipal and provincial levels.

3 Adoption–how the project outputs are being used

The project's farmer-managed demonstration sites, linked to FFS training, are being used as both information and training centres. The sites are also used by farmer groups to evaluate particular hybrid seed varieties versus 'native' varieties, and new crop options. Interestingly, at some sites, the native variety of ampalaya (bitter gourd) has shown improved pest resistance compared with the hybrid varieties. Further, commercial 'structural' improved farming techniques—including the use of plastic mulch for weed suppression and moisture holding, and monofilament fishing line for support of hanging crops (such as long-beans or ampalaya)—have been adapted by the farmers, through the use of vegetative crop residues to form a mulch and the use of native vines to replace monofilament line. The commercial materials are preferred by farmers, but financial constraints often necessitate use of 'free' natural resources. Such questioning and lateral thinking were encouraged during the training sessions, and assisted in farmers' acceptance of many of the improved techniques.

Consideration of agroeconomics was a new concept for many of the farming community members. An understanding of break-even income requirements has led many of the farmers and their supporting family members to keep farming supply cost, yield and market-return journals, which are used to assess income and

plan subsequent cropping options. The farmers have adopted these strategies to maintain a subsistence level of traditional crop production, while increasing their farm profits through the inclusion of high-value vegetable crops in their planting schedules.

Uptake of new monitoring tools and techniques for soil moisture profiling, introduced to Bureau of Soils and Water Management technical officers, has been hampered by failure to maintain equipment. Some of that equipment is now being taken up by the research group at Bohol Island State University, and may be used in student training and future monitoring initiatives.

FFS training was critically important in making the improvements effective. FFSs were shown to be highly effective in training farmers. They were able to increase farmers' skill levels from 'backyard' or non-professional vegetable farmers to skilled farmers within one cropping season. The first two FFSs were run by East-West Seed, but they are now run by farmers themselves.

Farmer-led FFSs have been just as effective as the schools run by project staff and East-West Seed. This is an important innovation in the FFS model because it can be a sustainable system. The farmer teachers selected from the initial FFSs were effective trainers and were also able to gain accreditation as farmer teachers from LGUs. Farmers accredited in this way have qualified for subsidy payments from the LGUs to provide training to new adopters, thus contributing to the financial stability of the system. Also, accreditation provides a rational and sustainable mechanism for financially compensating farmers for providing training. In the long term, perhaps some of the funds should come from the farmers who are receiving the training. This would require a change in mindset, but nevertheless is an important goal.

Study team measuring soil moisture profiles at San Isidro, Bohol. (Photo by J Bavor)

4 Impact–the difference the project has made or is expected to make

As outlined above (Section 2), a significant community impact of the project has been the establishment of a collaborative partnership with LGUs, through the municipal agriculture office, ICRAF and East-West Seed, for the implementation of FFSs on high-value crop vegetable production using improved technologies. The LGUs have provided some initial inputs through loans to farmers, using a microfinancing/honour repayment approach.

With the assistance of the municipal agriculture office, the project facilitated the drafting and approval of an ordinance that designates the project research sites as official Municipal Learning Centres for soil and water conservation, and improved farming practices. The LGUs have formally recognised the importance and value of the project, and, in some municipalities, are providing in-kind assistance in the use of municipal machinery, access to council market stalls for marketing farmer produce and by co-sponsoring farmer training sessions, as well as providing planting materials, fertiliser and loan financial support to participating farmers.

As part of the crop planning and marketing initiatives introduced through the project, farmers' wives and children are included in training sessions, and have contributed to evaluation of market demand for specific crops and to planning of cooperative local sales stalls. LGUs have been active in offering and providing market-stall venues for the farmer cooperatives. An impact realting to gender and age is that farmers' families have been drawn into farm journal and record-keeping activities. This has led to whole-family and community ownership, and ongoing interest in the project outcomes.

The project is leading to an understanding by farmers of the direct relationship between land practices, soil loss and loss of productivity. Thus, environmental sustainability is clearly linked to farming sustainability, a new concept for many of the farmers. Sustainable practices that have been demonstrated include ploughing-in of cover crop residues, vermicomposting and compost making. These practices are seen by the farmers as achievable means to improve soil fertility and crop yields.

A critical issue that initially limited farm productivity was the skill level of the farmers. Key factors included inappropriate cropping varieties, incorrect crop establishment, inappropriate planting density, incorrect use of fertiliser, poor pest and disease management, and inadequate irrigation.

Pest and disease management was an important issue for farmers throughout the project. The FFSs provided by project staff and East-West Seed significantly improved the pest and disease diagnostic skills of farmers working on the improved project sites. In all cases, after the FFS was completed, the level of pest and disease control improved significantly.

F1 hybrid vegetable seed supplied during the FFS sessions was being saved as second-generation (F2) seed, which is not true-to-type, and resulted in lower yields for follow-on croppings. This is a common problem among poor farmers who cannot afford to buy expensive F1 hybrid seed. After the FFSs, the farmers' understanding of the correct use of F1 hybrid seed improved. However, there is an ongoing issue with the correct use of F1 hybrid seed, and there is also a place for the use of good-quality inbred varieties, such as those bred by the World Vegetable Centre of the Asian Vegetable Research and Development Center in Taiwan.

Another critical factor limiting greater impact was the ongoing lack of finance to purchase basic cropping inputs. This project was unable to address that important issue. Farmers expect subsidies rather than funding inputs from expected profits. A sustainable long-term solution to the subsidy mentality needs to be built in to replace farmers' expectations that their cropping inputs will provided by someone else. Some LGUs have initiated a version of microfinancing in which the LGU advances basic planting and maintenance funding, and recoups the advance from the farmers' subsequent crop earnings. This is an important initiative and should be developed more fully to achieve sustainability. Another potential option in developing such a system could be to involve the private sector, such as East-West Seed or Harbest Agribusiness, in these types of initiatives, and attempt to form effective public–private partnerships between the private sector, LGUs and other organisations.

Postharvest crop management, transport and marketing strategies should be further promoted. Achieving increased yields of high-value crops may be of little value if the crops cannot be successfully marketed.

To be effective, key in-country partners must maintain a proactive, on-site presence at research sites. Some organisations, including ICRAF, have been successful in 'field-imbedding' staff with management experience and decision-making authority in a number of ACIAR projects. This approach should be viewed as a benchmark. ICRAF staff were important in the successful development of the community engagement and FFS initiatives of this project.

Further effort should incorporate farm budgeting in FFSs, based on the farm budget model approach that was developed throughout the project. Additionally, the self-sustaining microfinancing methodology to assist farmers should be further developed at provincial government and LGU levels to achieve wider adoption and to minimise the proliferation of a subsidy mentality within the farming community. These activities will improve the likelihood of adoption of practices that will return to farmers the greatest sustainable economic benefit, because improved practices will be adopted only when there are clear benefits to farmers.

Crop-plantings within vegetated strips increased the willingness of farmers to adopt use of vegetated strips. (Photo by J Bavor)

CSE2006/041 Increased productivity and profitability of rice-based lowland cropping systems in Lao PDR

PROFESSOR SHU FUKAI, UNIVERSITY OF QUEENSLAND; DR THAVONE INTHAVONG AND MR SIPASEUTH, NATIONAL AGRICULTURE AND FORESTRY RESEARCH INSTITUTE, LAO PDR; DR LEIGH VIAL AND MR JOHN SMITH, NSW DEPARTMENT OF PRIMARY INDUSTRIES

Project number	CSE2006/041
Project title	Increased productivity and profitability of rice-based lowland cropping systems in Lao PDR
Collaborating institutions	Australia: University of Queensland, NSW Department of Primary Industries Lao PDR: National Agriculture and Forestry Research Institute Thailand: Department of Agriculture
Project leaders	Shu Fukai, Monthathip Chanphengxay
Project duration	1 October 2007 to 30 June 2012
Funding	$1,763,568 total (ACIAR contribution $1,143,613)
Countries involved	Lao PDR
Commodities involved	Rice, maize, legumes
Related projects	CS1/1999/048

1 Motivation for the project and what it aimed to achieve

Rice is the most important crop in Lao People's Democratic Republic (Lao PDR), yet the productivity is not high, affecting food security, the livelihood of rice farmers and the economy of the country. Rice is mostly grown in the lowlands under rainfed conditions once a year during the wet season. One major problem is drought, which reduces grain yield in large areas. Some recently produced rice varieties are high yielding, but improved availability of new varieties with even higher yield, better quality and wider adaptation, particularly to drought, is required. Another major issue for lowland rice farmers in recent years has been the lack of labour availability on the farm as more attractive employment opportunities have become available in regional centres and overseas. Traditionally, farmers used hand transplanting, but this could potentially be replaced by direct seeding, particularly by broadcasting, which has a much lower labour requirement.

Although rice is the main crop for a majority of lowland farmers, some farmers have the option of growing other crops after harvesting rice, particularly in areas where irrigation water is available in the dry season. Non-rice crops often provide a more attractive economic return to the household's resources, and hence farmers could achieve a better livelihood if they could successfully diversify to high-value crops.

The project activities were conducted in three main rice-growing provinces of Lao PDR with four objectives:

- to produce geographic information system (GIS) maps, using a water balance simulation model that depicts the drought environment for rainfed lowland rice
- to identify advanced rice breeding materials, using participatory variety selection methods, that are well adapted and high yielding, and that are acceptable to farmers
- to determine and demonstrate the most appropriate rice direct seeding
- to determine the most appropriate crop management methods for maize and legumes.

Shu Fukai and Phetmanyseng Xangsayasane in direct seeded RD15 rice field. (Photo: Mr Tui)

2 Outputs–what the research project produced

GIS maps of the rainfed lowland rice environment of Savannakhet and Champassak provinces were produced. These provided information on the likelihood of drought occurrence in the areas, and the time when the crop could be planted and harvested.

About 15 rice varieties well adapted to the Lao lowland environments and well accepted by farmers were identified by the project. Three of them were subsequently released as official varieties TDK13, VTE450-2 and TDK36. Some of the varieties identified were more adapted to drought-prone areas, which tended to be the upper part of the topography.

The project provided seed (200–500 g), to each of approximately 400 participating farmers in around 20 villages, of three rice varieties out of those that were identified as promising in terms of high yield and farmers' preference. In addition, the farmers received seed of a variety of their choice from among 20 varieties the project grew in each village.

A direct-seeding technology package was produced and demonstrated to farmers. The package included a leaflet that described land preparation methods, the variety, fertiliser rate, establishment methods (broadcasting, drum seeding and seed drilling) and weed control measures.

Similar agronomic packages for maize and legumes growing in rotation with rice were produced. The information included land preparation methods, the variety, irrigation water requirements and fertiliser application.

A farmer growing project variety VTE450-2 in Champassak. (Photo Phetmanyseng Xangsayasane)

3 Adoption–how the project outputs are being used

The simulation modelling and GIS mapping have been taken up by other projects, and similar maps have been produced for different areas. The modelling has enabled the development of real-time forecasting of crop planting, harvesting and likely yield using current weather information and future forecasted weather. The outputs of this work have been used at the village level to assist farmers directly through the use of a dynamic crop calendar, in which the likelihood of drought occurrence is updated during the year to allow farmers to adapt their inputs and cropping systems accordingly. The modelling–GIS outputs have shown the system's capacity to minimise the impact of climate change on crop production. As a result, the government is in the process of establishing a new Centre for Climate Change Resilience in Agriculture, with the mandate of conducting research on climate risk in agriculture.

In the 10 rice-growing provinces in the country, the project variety VTE450-2 is one of the most popular varieties in three provinces in central–northern Laos; the variety TDK11—not developed by the project—is one of the top two varieties throughout the country. TDK11 was new to most farmers during the project period, and was tested during the project by providing seed to interested farmers. Adoption of the released glutinous varieties VTE450-2 and TDK36 is expected to be rapid because the seed is multiplied regularly at the government stations, and these varieties are well promoted by the government. Adoption of the released non-glutinous variety TDK13 will depend on market acceptance.

Interviews held recently with some of the participating farmers in Vientiane and Champassak provinces show that the adoption rate of project varieties provided to them during the project period was excellent in some villages, and moderate in others. In one village, the project varieties were the only ones currently grown, having replaced the old varieties completely. The villagers suggested higher yield—around 2.5 t/ha versus 3.5 t/ha for the old varieties—as the reason for this replacement. In another village, the farmers estimated that about 30% of the village rice fields was planted with a project variety.

Seed exchange within a village is common practice, and this contributed to the current popularity of the project varieties. High adoption of project varieties is perhaps not surprising because they were selected by participatory variety selection procedures, based on farmer preferences, and also on the basis of high grain yield, which was highlighted during the variety trials conducted by the project.

Adoption of direct seeding has taken place gradually in Laos. In Champassak Province, the direct-seeded area is about 10% in the wet season and 60–70% in the dry season. The direct-seeded area was almost 0% in 2007 when the project commenced; thus the increase in the direct-seeded area has been more than 10,000 ha during the past 8 years in the dry season alone. In Lahanam village, Savannakhet Province, direct seeding increased to the current level of 70% for both the wet and dry seasons. Direct seeding was more popular in the wet season than in the dry season in Vientiane Province in 2015. In the four villages surveyed, the area established from direct seeding ranged from 40% to 70%. Adoption of direct-seeding technology is likely to continue to increase with an expected increase in the cost of labour and a reduction in labour availability in the rural areas, and subsequent greater experience and generation of appropriate management techniques.

Among the three direct-seeding methods that the project examined and demonstrated, broadcasting appears to be the most popular in different parts of Laos. Drum seeding was another direct-seeding technology promoted by the project. In some villages, 20–50% of rice fields were planted using drum seeding. Drill seeding has become popular in Savannakhet, where the soil is sandy; in Outhompthon District, drill seeding was used for 30 ha in 2014, and more than 200 ha in 2015.

Adoption of non-rice crops (maize and legumes) appears variable in dry-season irrigated lowland areas. In some villages—for example, in Muang Kai village, Savannakhet—almost all available dry-season irrigation is dedicated to non-rice crops, particularly sweet corn, as a result of a combination of well-refined agronomy, a small, well-managed irrigation system and good markets. Similarly, peanuts are widely grown in Viengkham Tai village in Vientiane Province because of farmer connections to the marketing people, and access to the market.

The area allocated for maize and legumes in the dry season in lowland areas appears low in general; this tends to be related to factors other the production factors investigated as part of this project. Of several possible reasons, one main one is the limited market availability for these crops; a second reason is the limited provision of irrigation services; and a third reason is that all farm activities must compete with off-farm and non-farm opportunities.

4 Impact–the difference the project has made or is expected to make

The GIS mapping and modelling work is likely to have positive impacts on farming communities, with further advances in communication technologies and in weather forecasting capacity, as other projects use the modelling capacity that the project developed.

The project trials showed that the estimated mean yield advantage of new varieties over the standard variety at the time was about 3–7% in drought-prone areas of low soil fertility represented in higher topographic positions. This yield level was achieved with a growing duration that was 4–10 days shorter than for the standard variety. This shorter growth duration would result in reduced risk during drought and an increased opportunity for double cropping. As well, the eating quality was higher for the new varieties than for the standard variety, which has a hard grain texture.

The community benefit of direct seeding is mostly through labour saving. The yield of a broadcast crop is generally similar to that of a transplanted crop, and the project survey of 76 farms estimated the mean yield reduction due to direct seeding as 4%, or 140 kg/ha. Using the 140 kg/ha reduction in yield, the project estimated an annual benefit of about US$6–7 million for a rice area of 50,000 ha (6% of the total rice area in Laos) if the labour cost is 50,000 kip/day. It is likely that the current direct-seeded area is more than 6%. Many other projects in addition to the current one, including our previous ACIAR project, have contributed to the current popularity of direct seeding, making it difficult to single out the contribution of any particular project.

An aspect of the social impact of direct seeding is that the hard field work of pulling seedlings and transplanting, which is often undertaken by female workers, is reduced. Thus female family labour could be engaged in other work instead, and this would have an impact on gender equity.

Weeds are a common problem with direct seeding, and herbicides could be used to reduce the weed problem. The use of herbicide does not appear to be widespread at the moment, but, even with the application of a range of traditional weed-control techniques, it is likely to increase with further increases in direct seeding.

The community impact of the adoption of non-rice crops appears to be rather small, and confined to isolated success stories, because of the limited adoption of such crops. Thus the non-rice crops could become a source of good income generation, should the right market develop for various crops in different districts. Since the major impediment appears to be a lack of market access, it would be useful to look at the value chain of key non-rice crops and establish connections with markets; the agronomic research will then become more meaningful, providing larger community impact. There are now sufficient success stories using non-rice crops in different provinces to provide good insights on this success.

Research appears to be more effective when groups of farmers are involved, rather than researchers interacting with individual farmers in isolation. Farmer-to-farmer communications in group situations produce more generally applicable outputs. In addition, the adoption rate appears much higher, particularly when more complex change is required for adoption. Farmer-to-farmer interaction appears most effective in combining old and new knowledge to make a technology work in the relevant context; the final application of the technology can look quite different from what the researcher first envisaged.

LWR/2006/158 Enhancing institutional performance in watershed management in Andhra Pradesh, India

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Project number	LWR/2006/158
Project title	Enhancing institutional performance in watershed management in Andhra Pradesh, India
Collaborating institutions	Australia: La Trobe University India: Indian Institute of Management (Ahmedabad) India: International Water Management Institute
Project leaders	Lin Crase, Vasant Gandhi, Floriane Clement
Project duration	2008–13
Funding	$1,903,337 total (ACIAR contribution $815,917)
Countries involved	India, Australia
Commodities involved	Rainfed agriculture
Related projects	LWR/2006/072, LWR/2010/015, LWR/2007/113

1 Motivation for the project and what it aimed to achieve

In 2008, ACIAR commissioned an analysis of the institutions that support watershed development (WSD) projects in India. The project focused on Andhra Pradesh, where different approaches to the roll-out and administration of WSD had been trialled over a number of years. The aim was to better understand the institutional set-up that led to better performance of WSD, especially as such programs had been given a high

priority by both state and national governments, and were attended by significant resources. For example, at the time the project was commissioned, around $US500 million was being expended annually on WSD alone, and this was complemented by additional resources channelled through the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS)—an employment scheme whereby rural workers were paid from central funds to participate in labour-intensive projects of community significance. By the end of 2013, total government spending on WSD across India was estimated to be about $US4 billion per year.

Notwithstanding some of the successes of WSD leading up to the project, experience had also shown that, in a significant proportion of cases, farmers and villagers had little enthusiasm for adopting the proposed WSD technologies, and program failures were quite common. Anecdotal reasons for failure included the weak linkages among institutional structures, poor performance of these structures, and dysfunctional rules and operational systems. Understanding and dealing with the weaknesses in the institutional apparatus for delivering WSD was thus expected to directly improve the outcomes from the substantial investments in such programs. Importantly, these programs had a strong focus on poverty alleviation, so making public monies go further would necessarily improve the plight of disadvantaged groups.

An important objective of the project was to specifically test institutional performance empirically. Although officials involved in WSD had anecdotal evidence of success (and failure), there was no systematic means of documenting the drivers of success and thus only a limited chance of replicating good practice across multiples sites.

At the time, this topic was of intense interest to the Department of Rural Development (DRD), and the Special Commissioner and his successor Commissioner were both keen to improve the efficiency and effectiveness of program delivery.

2 Outputs–what the research project produced

The project collected data from a large sample of beneficiaries of WSD programs. They included farmers and landless people who had been involved in enterprise development as a consequence of self-help groups, since these groups were included in some of the later WSD initiatives. Attention was also given to the higher-order institutions that influenced the guidelines under which WSD was implemented by states. More specifically, the way that national officials designed protocols and the manner in which they were interpreted by state officials was also considered.

The primary data from the village level were specifically interrogated to establish whether there were empirical relationships that could explain the drivers of successful WSD implementation. Overwhelmingly, the data supported the view that the impact of WSD in rural India, when delivered appropriately, was positive. Important determinants of success were identified empirically; they comprised:

- attention to technical details, such as ensuring that on-ground works were appropriately designed and located to yield the best possible outcomes for agriculture and the environment
- environmental soundness of projects, ensuring that water and soil conservation were achieved
- appropriate institutional architecture to ensure ongoing investment in strong and well-trained local organisations
- adequate control systems, including auditing capacity.

The project data also supported the view that WSD generally was more effective when the program sought to address broader social issues, such as including initiatives that would benefit the landless through self-help groups.

3 Adoption–how the project outputs are being used

At the conclusion of the project in 2013, there was considerable promise for WSD, and the outputs from the project were unequivocally welcomed by DRD officials. More specifically, DRD in Andhra Pradesh created separate watershed committees at the village level and sought to engage more heavily with non-government organisations to support these committees. A recruitment effort was undertaken to expand the technical skills on hand for WSD, and the thrust to combine broader social initiatives with agricultural gains was confirmed with actions. The Integrated Watershed Management Program (IWMP) version of WSD included a strong focus on establishing self-help groups operated by women, and these created rolling funds to support a range of activities. The necessity to have clear rules and focused institutions at the local level also became a feature of the program. At the national level, the National Rainfed Area Authority (NRAA) picked up the findings of the work and incorporated elements into national guidelines that shaped the program across the country. More specifically, the NRAA and the Planning Commission joined forces in 2011 to revise the 2008 guidelines for WSD, directly responding to concerns and insights provided by state departments. In the case of Andhra Pradesh, the project was pivotal to these discussions. In addition, the project team liaised directly on this topic with Dr Alok Sikka, Deputy Director General, Indian Council of Agricultural Research and Technical Expert (WSD), NRAA.

The WSD program continued to develop momentum after the study concluded, including further amendment of the national guidelines in 2013 (the so-called Neeranchal Guidelines) that were designed to give additional impetus to the IWMP approach. The IWMP placed greater emphasis on community participation in planning and had a broader set of objectives, beyond technical changes to the agricultural landscape. Under IWMP, 90% of funds for WSD were provided by the national government, and 10% of funds were provided by state governments, with monies being directed from the national government to the state-level nodal agency, in this case Andhra Pradesh DRD. A modified institutional structure consequently emerged that was both sympathetic to the findings of the ACIAR research and took advantage of new interest in this field.

Some notable features of these arrangements included the following:

- Innovative use of expertise and technologies was used to spread knowledge at low cost. For instance, software was progressively developed to improve the accuracy of design and reduce the time to formalise plans, particularly estimates that attended WSD structures.
- Computer systems were deployed to ensure that funds were directly provided to providers and end users of materials and services, without leakage; these systems were ultimately advocated at the national level.
- Social audit processes were instigated at the village level that gave local end users a stronger voice when reviewing the implementation of WSD plans. Non-government organisations played a key role in mobilising interest in WSD, although technical matters were supported by state-hired experts, often graduates from university programs.

- Extensive training and capacity building was undertaken for farmers. For example, more than 700 leaders from watershed committees undertook exposure visits annually to make them aware of the scope of WSD interventions. Similarly, large numbers of women involved in self-help groups travelled to gain additional insights on the possibilities for enterprise development.
- So-called 'convergence' between WSD and the MNREGS was well established, leading to positive outcomes in terms of both employment and natural resource management, since many of the labour-intensive works focused on water and soil conservation.

In June 2014, Telangana state was created, and Andhra Pradesh was formalised as a separate but smaller jurisdiction. These arrangements effectively resulted in a bifurcation of the state public service that had supported WSD and other services. Some staff remained involved with WSD, but other circumscribing events have also affected the progress of WSD.

In addition to the bifurcation, the national government opted to modify the funding ratios that underpinned WSD projects. The 90% share carried by the national government was reduced to 60%, and projects are now only sanctioned if deemed worthy of the 40% support from the state. Adding to this complexity was the decision by the national government to transfer funding for WSD directly to states, in preference to directly funding state-level nodal agencies (such as the DRD). Finally, priorities for the use of the MNREGS have not remained constant, giving rise to marked differences in WSD between Telangana and Andhra Pradesh, and thus different impacts of the research project.

4 Impact–the difference the project has made or is expected to make

To understand the impacts of the project, it is important to recognise that the contextual elements of WSD in Telangana and Andhra Pradesh now differ markedly. In that regard, impacts of the ACIAR work are reported separately for the two jurisdictions.

Telangana

The priority assigned to WSD is now different in Telangana from that in the former unified Andhra Pradesh. Specifically, the state has given a high priority to large projects, such as rehabilitation of large irrigation tanks and development of a potable water network for the entire state. This has had some bearing on the financial support that attends WSD projects.

Interviews with those involved on the ground indicate that state resources have not been forthcoming for WSD projects since 2014. There is also some evidence that the national government monies set aside for WSD have not yet made their way to WSD activities in rural areas. This has given rise to several responses from those involved in WSD. First, wherever feasible, WSD activities that can be undertaken with the MNREGS are being progressed, albeit without any accompanying activities that may require direct cash. Second, staff trained in WSD continue to engage with communities in an effort to shore up enthusiasm. In some cases, this is done through agencies other than the DRD, with WSD staff now working through other government channels.

The upshot is that the impacts of the research project aimed at improving institutions to support WSD are mixed in Telangana. For example, in communities where the IWMP is already well established (e.g. self-help groups that were well resourced and had firm foundations), the withdrawal of state support is less noticeable. These communities, by and large, have accumulated benefits that seem likely to endure. The input from the ACIAR research around the importance of clear sets of rules for organising groups is bearing fruit here. For instance, data on WSD show that self-help groups have been universally successful when the rules around lending and repayment are clear, resulting in a near-zero default in villages surveyed. Some issues remain to be addressed on the agricultural front, such as ensuring that beneficiaries maintain the physical structures that have led to greater water availability, but these challenges are not insurmountable, and local solutions are emerging.

In contrast, communities that were involved in earlier versions of WSD appear more exposed to the reduction in government support. Where social capacity through self-help groups was not given high priority, communities remain anxious about reductions in government support. Offers by state agencies of further assistance to at least equate the assistance given to villages in the IWPM have not been fulfilled. Disaffected communities remain more heavily reliant on state sponsorship than neighbouring communities who have assembled significant financial and social capital under the IWMP. Thus, while the agricultural benefits that accrue to landholders are clear in these cases, the wider community benefits, especially for the landless, are unlikely to be realised in the near future. Clearly, for those communities not yet exposed to WSD, or where projects are stalled and only partially completed, the impacts of shifting state priorities will be complex. In particular, the outcome will be a function of the gains from new priorities, but this topic sits outside the scope of the current report.

Importantly, the overarching institutional lessons from the project have not been lost on government and non-government operatives. Consistent feedback has been received on the importance of engaging with communities broadly by having clear rules and mobilising community effort as a precursor to intervention. For instance, against a backdrop of funding shortfalls for WSD, officers working for other departments (e.g. agriculture, soil conservation) regularly use similar 'entry point' activities to those devised under WSD to gain community input and support. This approach was similarly clear in Andhra Pradesh.

Andhra Pradesh

In contrast to the situation in Telangana, WSD remains a high priority for the Andhra Pradesh government, and funding for projects has continued unabated. State officials note that the changing national:state funding ratios have necessarily slowed WSD works but, as with Telangana, 'convergence' (i.e. use of the MNREGS) continues to offer scope for continuing and expanding the number of projects.

The impacts from the research on institutions are more discernible in Andhra Pradesh, and subsequent innovations and improvements are also noticeable. Among these are:

- ongoing support for exposure visits to harness community support for the program
- continuing use of the IWMP as a vehicle to both expand the equity of WSD programs and gain greater buy-in from a broader range of the citizenry
- increasing familiarisation with the centralised systems that generate plans and approvals

- noticeable reductions in out-migration due to enhanced economic opportunities in rural areas—this is particularly evident in villages where formerly marginal lands have become productive, as is the case in mandals (districts) such as Kurnool and Ananthapur
- increasing interest on the part of communities to be involved in auditing outcomes (part of the so-called social audit process).

Challenges continue nonetheless; they include:

- ensuring that farmers are able to take advantage of increases in water availability and to make use of that water in an efficient manner (both technically and economically)
- ensuring ongoing vigilance with regard to financial accountability of public monies
- capturing and documenting successful outcomes from projects, in preference to simply auditing and acquitting inputs
- expanded confidence of communities, resulting in increased political activism and a resulting divergence of resources from productive activities.

Nonetheless, there is clear evidence that WSD in Andhra Pradesh continues to grow and has a positive impact on rural livelihoods in rainfall-dependent areas. The research project has contributed to that success by providing a means of contemplating efficient and effective support structures for the program. The research has also had a national effect by altering the national guidelines for WSD in a way that enhances the overall effectiveness of WSD.

At the conclusion of the initial research, it was estimated that farmers' incomes in the unified state of Andhra Pradesh could feasibly rise by $US460 million as a consequence of more efficacious delivery of WSD programs. The contraction of government investments in WSD in Telangana may have had some impact on those benefits, but the wider gains from the project on improved program delivery in other states probably offset any impacts in Telangana. Moreover, given the overall magnitude of the national program and the discernible improvements in governance that attended the research, the investment of $A815,920 is well justified.

The shifting policy landscape in these regions supports the view that ACIAR projects can have a lasting impact beyond agriculture. Australian-sponsored applied research remains highly valued in India, and the lessons learned in one arena of policy can often emerge in different settings. The translation of findings from the WSD program to other interventions in rural India provides good evidence of this phenomenon.

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