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International Agricultural Research

Foraging for a future in Laos

PARTNERS
IN RESEARCH FOR DEVELOPMENT

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INSIDE

RECOGNISING THE VITAL ROLE OF RICE

The United Nations has named 2004 as the International Year of Rice, reflecting the importance of rice as a primary food source for more than half the world's population. 'Rice is life' is the theme of the International Year of Rice. As a source of food security, as a way of life upon which many traditions are built and as a foundation of farming enterprises and trade, rice is vital.

One country where this is particularly so is Cambodia. In the past decade, as Cambodia has emerged from its recent troubled past, increased rice production has been an important economic driver.

Australia has played a role in this, most notably through work supported by AusAID, ACIAR and IRRI, to improve the rice varieties grown in Cambodia. The on-going partnership between IRRI and ACIAR is featured in this magazine.

But there is more to agriculture in Cambodia than rice, and ACIAR has recently developed a small suite of projects to help in the diversification of agricultural industries.

Increasingly in a global world, agricultural expansion and diversification can provide the means to improve livelihoods and build sustainable futures for poor farmers.

With Cambodia seeking WTO accession and entering export markets, the timing is right to expand agriculture.

Work on animal health, much of it being carried out in Laos, and applicable to Cambodia is one area where ACIAR is supporting agricultural expansion.

Rice will remain Cambodia's staple crop and the foundation on which much of this expansion is built. Agricultural research for sustainability, including that supported by ACIAR, has an important role to play in Cambodia's, and the region's, future.

PARTNERS
IN RESEARCH FOR DEVELOPMENT

Partners in Research for Development presents articles that summarise results from ACIAR-sponsored research projects, and puts ACIAR research initiatitives into perspective. Technical enquiries will be passed on to the appropriate researchers for reply. Reprinting of articles, either whole or in part, is welcomed provided that the source is acknowledged. This publication is freely available from ACIAR's website at *www.aciar.gov.au*. It is also freely available on request from ACIAR.

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Executive Editor: **Warren Page**, ACIAR, +61 2 6217 0500

Managing Editor: **Brad Collis**, Coretext Pty Ltd, +61 3 9318 9362

Design and Production: Coretext Pty Ltd *www.coretext.com.au*

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Letters from readers are welcome, and should be addressed to:
The Editor,
Partners in Research for Development,
ACIAR,
GPO Box 1571,
Canberra, ACT 2601,
Australia.
email *comms@aciar.gov.au*

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IN THIS EDITION

SPECIAL FEATURES

CAMBODIA'S JOURNEY

When Australian agronomist Harry Nesbitt first trod Phnom Penh's deserted smoke-blackened streets in 1988, the task of re-establishing a whole country's ability to feed itself seemed hopeless.

Responding to an urgent summons from IRRI and AusAID he found almost all knowledge of traditional rice farming practices had been lost – varieties and their traits, soil characteristics, irrigation and drainage, plant breeding, cultivation, and pest management.

The country's trained agriculturalists had either been murdered or forced to flee, and farmers had been relocated to work unfamiliar soils and terrain.

Nesbitt's first priority was to prevent a famine. His next was to rebuild a system of national agricultural research; a program that eventually was formalised as CIAP – the Cambodia-IRRI-Australia Project.

Today CIAP has made way for CARDI – the Cambodian Agricultural Research and Development Institute – and the research targets have broadened considerably from food security to the development of diverse, high-production agriculture.

There is still an enormous distance to travel, but the journey towards modern agriculture that barely seemed thinkable a decade ago, is now under way in earnest.

On pages 4-10, BRAD COLLIS reports on some of the ACIAR projects that are helping to transform the focus of Cambodian farming from rice-based food security to a diverse agricultural economy.

RESEARCH FEEDS A NATION'S FUTURE

ACIAR is playing an important role in this new stage of Cambodia's agricultural development, supporting key areas of research into new crops for more diverse and intensive farming systems, improved animal health as livestock production begins to lift, and in the staple area of rice – improved quality and production systems with an eye to future exports.

"We are moving from one crop, rice, to a variety of fruits, vegetables and crops such as maize and chilli," explains CARDI's inaugural director, Dr Men Sarom.

"Food security is still important and still needs ongoing research, but our mandate has been broadened to also look at ways to improve living standards by developing crops that can compete for quality against imports," he says.

Dr Sarom says CARDI and its basic research is crucial if Cambodian farmers are to have ongoing technical support, and if agriculture is to play the role it needs to play in making rural communities more secure economically and socially.

"To do this, research has to be provided for every part of the country. There are still large areas that are missing out because we don't have the scientific resources," he says.

"So support from agencies like ACIAR remains critical. Yes, we have come a long way, and some say it is time to stand on our own feet – but really we are still laying our foundations."

Dr Sarom also says there is a rapidly emerging need to match higher yields and higher quality produce, with avenues and infrastructure for marketing: "Farmers are seeing yields and quality rising, and are now asking how they are going to sell this improved production."

Dr Sarom hopes part of the answer will be found in CARDI's newly established business unit. However, he believes the long-term answer to marrying improved production with a market economy will be the intervention of a third-party trading house; a specialist marketing body. Even though this development is still somewhere in the future, the fact it is even now on the agenda is testimony to the progress being made at the farm and village level.

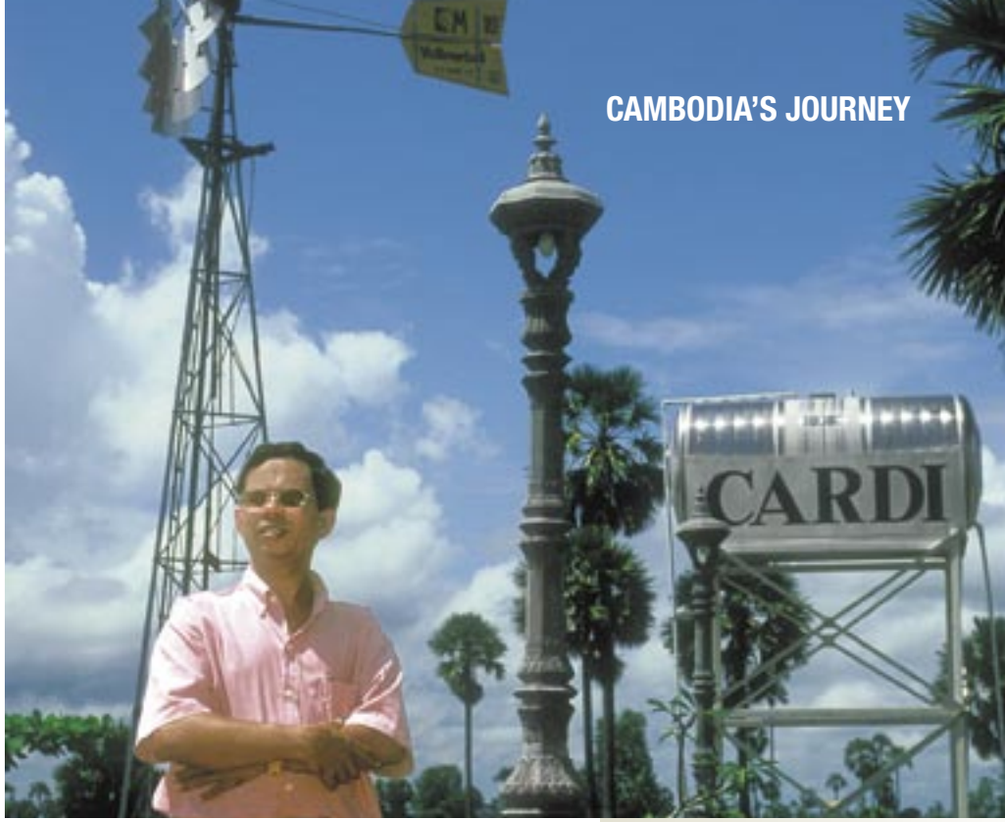
Project leader of ACIAR's crop diversification program is CARDI's deputy director, Ms Chan Phaloeun, who with Men Sarom was one of Harry Nesbitt's early protégés.

Phaloeun says CARDI's three priorities are:

- A Cambodian Government policy to raise local rice varieties to export quality;
- Development of legumes and maize; and
- Horticulture.

"While there has been progress, our farmers are still very poor so our charter to diminish poverty remains the primary objective," she says. "However, we also need to stimulate socio-economic growth."

Phaloeun says the crop diversification project is ▶



Improving systems: director of CARDI, Dr Men Sarom.

specifically targeting upland areas that grow rainfed rice and cash crops. These areas missed the first wave of research during the CIAP period which was aimed at helping the traditional lowland rice areas to simply feed everyone.

(The research priority in the irrigated lowland regions is intensification rather than diversification.)

The upland diversification project's first stage has been a survey of existing systems, soils and agronomy. The survey, and the first trials, have been in the Batdambang and Kampong Cham provinces where soils range from very poor through to highly fertile, and where there is some diversification already with rubber and peanuts.

"We need to learn what else these different upland soils can sustain, in particular crops that can be grown in rotation with rainfed rice.

"As a country we are looking to reduce our reliance on rice, but for farmers this reliance is still very strong. Even though non-rice crops will earn more than rice, farmers prefer rice because (a) they know it, (b) the seed keeps for a long time so it offers security and (c) it is their staple diet."

Phaloeun believes there is considerable potential in the uplands for farmers to grow two crops a year without irrigation, but a lot of work needs to be done on basics such as time of planting, appropriate varieties, and pest and disease control.

"Cambodian farmers are still nervous about change and need to see results before taking a risk."

Joint project leader, Dr Bob Martin from NSW Agriculture says the upland diversification project is concentrating on six crops – corn, soybean, mungbean, peanuts, sesame and cowpea.

"The aim is to improve farmers' cash incomes, as well as to provide a better variety of food in people's diets," he says. "We began by looking at the issues that might hinder this, such as soils and lack of suitable varieties, and we are now confident that we have identified a good mix of suitable crops. We've brought in varieties from Thailand and Australia, and these have been introduced into CARDI's breeding programs.

"Now we are ready to tackle some basic agronomy – crop rotations, the management of pests and diseases, whether or not upland legume crops do provide nitrogen for subsequent non-legume crops.

"In the next full season of work we will also look at whether or not these legumes need rhizobial inoculation, and also techniques for improving soil moisture retention.

"Just as happened in Australia, farmers plough after the first rain, which means most of the moisture is immediately lost, and they then have to wait for the follow-up rain before planting the crop.

"So we are going to look at improving soil moisture management through minimum tillage and stubble retention as a way of allowing farmers to sow much earlier. Sowing earlier would see them get the crop through before the main flush of insects."

The crop diversification project is now working hand-in-glove with the land suitability/soils assessment project under associate professor Richard Bell from Murdoch University.

Professor Bell, working with Dr Peter White from the Department of Agriculture in WA and CARDI's Dr Seng Vang, is assessing upland soil types for non-rice crops.

He says the catalyst for now turning to crop diversification is that Cambodia has now been self-sufficient in rice, at a national level, for several years.

"Lowland rice is the dominant subsistence crop for most rural households, however diversification can be achieved by growing field crops either before or after growing rice," he says. "In addition there is substantial untapped potential to expand the production of field crops such as maize, soybean, mung bean, peanut and sesame in the uplands where a lot of land is unsuited to rice.

"We will conduct detailed studies in a single district in

Diversification: CARDI deputy director Chan Phaloeun (right) meets with farmers to discuss their changing needs.

Focusing on five crops: Dr Seng Vang, head of CARDI's soil and water sciences program.

each of three key provinces – Takeo on predominantly sandy soils, in Kampong Cham on basaltic soils, and in Batdambang on mixed geology."

Professor Bell says the variety of soils in each district will be described and mapped, with Noel Schoknecht of the WA Department of Agriculture providing the key technical input.

For each of the soils, key limiting factors will be identified and rated in severity to determine the capability of the land for field crops. Apart from the soil survey the team will also use on-farm experiments and interviews with farmers and local agriculturalists.

"Land capability is an assessment of the bio-physical resource and its potential for sustainable use. However, socio-economic factors also need to be considered in determining the most suitable use of the land," says Professor Bell. "So we will examine socio-economic factors such as market accessibility for field crops based on road condition and distance to markets."

Dr Vang, head of CARDI's soil and water sciences program, says the land suitability project is focusing on five crops – maize (corn), mungbean, soybean, sesame and peanuts.

He explains that because the upland regions have always relied on rainfed rice, these areas should be more conducive to crops such as these. "And we are looking at ways to increase production in relation to water availability and soil constraints," he says.

The main soil constraints are deficiencies in nitrogen, phosphorus and in some areas, iron.

Upland areas essentially have three seasons – early wet season, main wet season and the dry season. Agronomists believe there is potential to add crops to the early wet season, when the rainfall is traditionally too unreliable for rice, but may be enough for less thirsty crops.

However, Dr Vang says that in addition to finding crops that can be grown during this period, there is also a potential sociological hurdle – introducing an additional cropping regime to the village calendar.

"Finding the crops might be the easy part. The main task will be to match this with farmers' capacity to change," says Dr Vang. "Also, if we are to introduce another crop outside the annual rice crop it will have to be highly marketable. No matter how successfully they might grow new crops, if they can't sell them they will revert immediately to their basic crops.

"Marketing support is going to be as important as technical support."

Dr Vang says that while there are always 'early adopters' the introduction of a new, diverse, cropping system will be difficult for most farmers, especially if it involves investment and risk.

He says farmers have shown they can be very receptive to change, but the benefits have to be demonstrated first: "We will have to make sure that all the factors that farmers can control, such as choice of variety, time of planting, are right, before they are going to take the next step and spend money on fertilisers.

"In the lowlands you can make a mistake, but still get a rice crop. In the uplands, a mistake means you get nothing, so food security is still the main issue."

This quest to increase the adoption of crop diversification in Cambodia also has a twin project running in Western Australia. In Cambodia, the project is assessing land suitability for non-rice crops. In WA, the project is assessing land suitability for pulse cropping under a range of production scenarios.

While there are clear differences between the rice-based agriculture of monsoonal Cambodia, and the wheat-based agriculture of Mediterranean southwest Australia, there are significant common interests. Agriculture is dominated by a single cereal crop in each case, and while diversification opportunities appear to exist, there are key blockages in adoption.

The underlying premise of the project is that a more explicit description of the limiting biophysical and socio-economic factors will help to improve adoption of crop diversification in both countries.

PROJECTS:

ASEM/2000/109 Farming systems research for crop diversification in Cambodia and Australia

Contact:

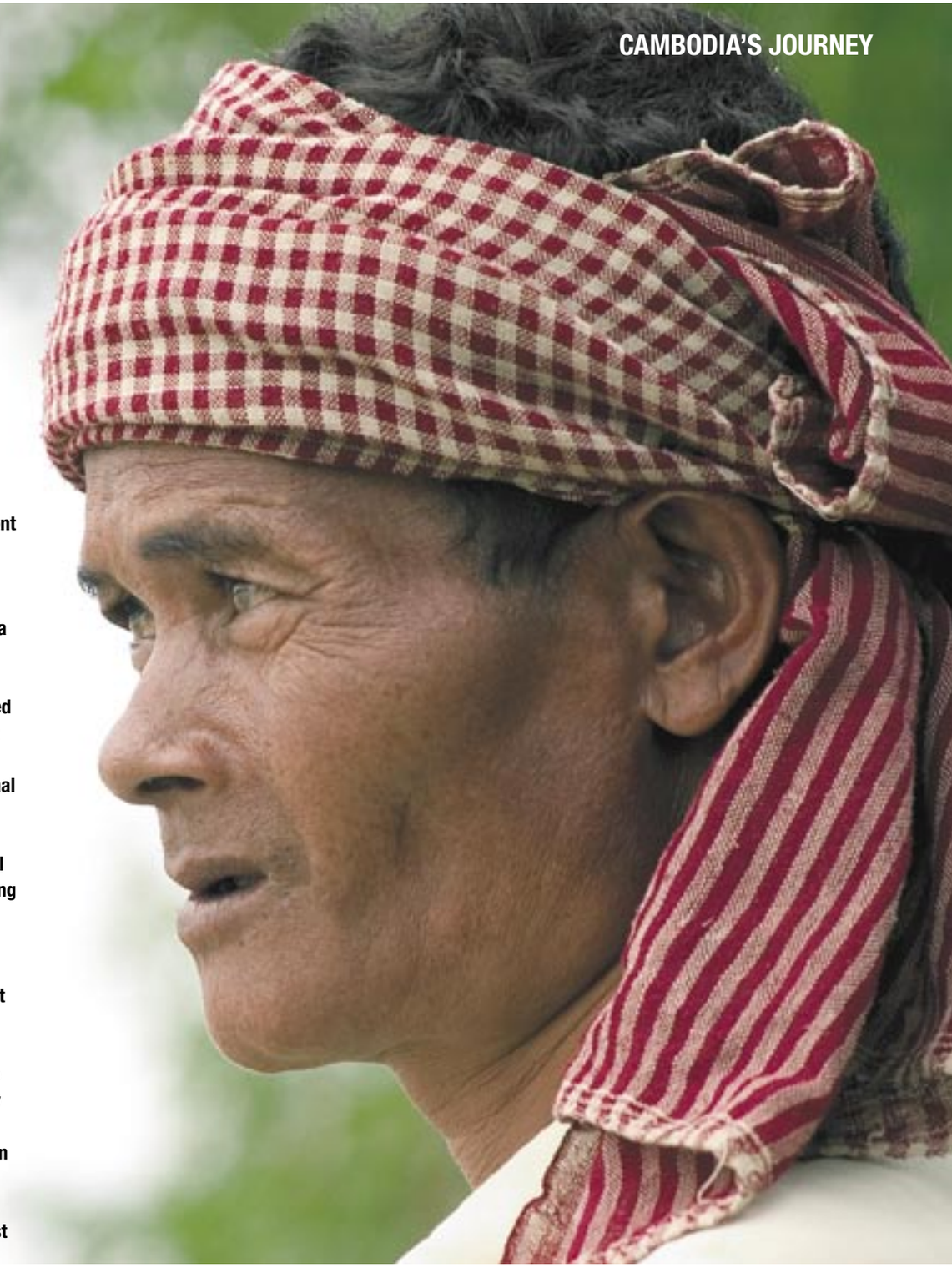
ACIAR, Dr Ken Menz, Research Program Manager, Agricultural Systems Economics and Management, +61 2 6217 0500, *menz@aciar.gov.au*

LWR/2001/051 Assessing land suitability for crop diversification in Cambodia and Australia

Contact:

ACIAR, Dr Ian Willett, Research Program Manager, Land and Water Resources, +61 2 6217 0500, *willett@aciar.gov.au*

ACIAR'S KEY ROLE



Beyond rice: a Cambodian farmer contemplates a future that is now stretching from subsistence to sustenance to enterprise.

ACIAR's recent role in helping Cambodia expand and diversify its agricultural sector continues Australia's development assistance, which played a key role in the country's return to self-sufficiency.

In 1986 scientists from the International Rice Research Institute (IRRI) visited Cambodia to assess research and training needs. The Australian Government, through AusAID, responded by funding initial studies that helped establish the Cambodia-IRRI-Australia Project (CIAP).

CIAP, by placing Australian and international agronomists in-country, lifted Cambodia's rice productivity, achieving self-sufficiency in 1995. Since that time the focus of international development assistance has been on developing more sustainable whole-farm production systems, including diversifying production beyond rice.

ACIAR's strategy in Cambodia is to support research that underpins this diversification, while also increasing the productivity of rice-based farming systems. Rice remains both the staple food crop and the basis of food security for much of Cambodia.

Cambodian farming is still largely based on rice systems of relatively low productivity.

Increasing the security and income that rice offers farmers, helps enable them to invest in more diversified agricultural activities. Increased productivity also frees up land from rice cultivation. ACIAR's suite of current and pipeline projects targets rice productivity, as well as corresponding areas of research that support agricultural diversification.

Projects currently underway include developing the basis for improved livestock productivity through addressing animal diseases, including through projects in neighbouring countries, aquaculture for smallholder farmers and improvements in marketing systems for non-rice crops.

All of these projects have, as a central role, the building of Cambodian scientific expertise and capacity. Scientific capacity also continues to be restored through the AusAID-funded Cambodian Agricultural Research and Development Institute Assistance Project, of which ACIAR is managing a component.

The Cambodian Agricultural Research Fund is helping to establish a competitive research sector through provision of competitive tendering for agricultural research.

Successful applicants receive training to undertake research problem identification, preparation of proposals and report writing necessary to interact with the international scientific community and donors.

ACIAR has also linked several of its research projects to AusAID-supported extension, industry development and institutional capacity-building initiatives.

MULTI-LEVEL APPROACH TO STRATEGIC RICE BREEDING

Search for quality: CARDI research assistant Then Rothmuny oversees rice seed being planted as part of a breeding program to lift the quality of Cambodian rice.

A key plank in the platform Cambodia is building for a more commercial agricultural sector is the ACIAR-supported project to increase production in the core rice-based cropping systems.

A multi-level approach is being taken to develop more efficient breeding strategies, and to use these to speed up the development of important advances such as drought-tolerant rice varieties, and to develop the right agronomy for other crops such as mungbeans to be grown in rotation with rainfed lowland rice.

Efficient testing: project researcher Dr Makara Ouk.

The project is also trying to resolve the issue of whether or not farmers should direct seed, or transplant seedlings. Farmers are divided, but the research so far is not finding a strong case to support one method against the other.

The efforts at CARDI to increase production in its rice-based systems are part of a wider project with similar goals in Lao PDR and Australia.

Project researcher in Cambodia, Dr Makara Ouk, has been concentrating on developing a more efficient plant breeding program by eliminating unnecessary trial locations and years, before a breeding program begins.

"We started out with the question: 'Do we need to test in so many locations, and over how many years do we need to test to determine the selections for a breeding program?'," he explains.

After three years studying 34 genotypes from various sources in multiple locations, Dr Ouk says his team has concluded that a reliable starting point for breeding requires no more than eight multi-location trials in order to select enough broadly adapted cultivars.

Further, he says they have shown that these pre-emptive trials need only run for two years.

This represents a significant reduction in the preparatory work needed for selecting cultivars for breeding programs.

Dr Ouk says that if there is a business side to plant breeding in a developing country, then it is to minimise the work and to maximise the results of that work.

This strategy for selecting broadly adaptive cultivars now forms the basis of all of CARDI's breeding programs – including the search for drought-tolerant rice varieties.

Drought-resistant lines identified in these projects are being used as donors for new populations that will help the development of agronomically acceptable, and widely adaptable, cultivars.

Dr Ouk says five genotypes have so far been identified as having the potential to develop into drought-tolerant varieties.

An interesting aspect of the research has been the development of a method of simulating late season drought conditions in the wet season for plant selection. ▶

PROJECT:
CIM/1999/048 Increased productivity of rice-based cropping systems in Lao PDR, Cambodia and Australia

Contact:
ACIAR, Dr Colin Piggin, Research Program Manager, Crop Improvement and Management, +61 2 6217 0500, *piggin@aciar.gov.au*

Developed in Thailand by the ACIAR project, and adapted by researchers in most countries in South-East Asia, the procedure is to drain paddies during the reproductive phase of growth and then to keep the soil dry.

Using this technique, the CARDI researchers are looking for traits that can be related to drought tolerance – such as delayed flowering, phenology, drought response index and leaf water potential. Under drought conditions some genotypes are known to transpire more slowly.

A third component of the project has been to try and resolve the arguments over whether direct seeding or seedling transplanting produces better yields.

Research over the past three years has not found one method to be better than the other, although some genotypes, when direct seeded, suffer yield losses through lodging.

Dr Ouk says these genotypes have been observed to develop narrower and taller stems under direct seeding, but he says it is an observation that has yet to be tested.

However, aside from the yields debate, it has been shown elsewhere that direct seeding can shorten the planting time and reduce labour needs for transplanting.

A direct seeding experiment at Savannakhet in Laos showed that higher seed rate (200 kilograms per hectare) in broadcasting could produce higher grain yield than lower seed rates. However, it appears this can be offset by higher seed rates leading to small seed.

Wanting support: Mr Katam Sonavann, chief of the Agronomy and Agricultural Land Improvement Office at Kampong Cham province, says farmers are eager for knowledge.

KNOWLEDGE BRINGS NEW HOPE

Land suitability trials in the Kampong Cham province are covering both rainfed upland and lowland systems, with a view to identifying a wider range of crops that will maintain food security while increasing household incomes.

Mr Katam Sonavann, chief of Agronomy and Agricultural Land Improvement in Cambodia's Ministry of Agriculture Forestry and Fisheries' Kampong Cham office, says farmers are eager for knowledge and for more choice, but have not had the necessary technical support.

He says there is now a lot of hope that trials with mungbeans, corn, sesame and peanuts will help to lift, and diversify, production – and break farmers free from their traditional subsistence culture.

The trials are not only exploring the range of crops, but are also measuring the effects of fertiliser, and improved nitrogen fixation by soybeans when the soil is first inoculated with nitrogen-fixing rhizobia bacteria. Cambodia's soils lack natural soil rhizobia.

A leading farmer in one village that is hosting ACIAR-supported trials, Mr Long Chhem, says he and his neighbours are putting considerable hope in the research that is taking place.

This has a lot to do with the massive increases in rice yields that the farmers have enjoyed since adopting, after a protracted village debate, the modern rice variety IR66.

The villagers resisted the variety for years, out of fear of change. When finally they took the plunge, the new high-yielding variety changed their lives. They have similar hopes for some of the new crops, although researchers and extension officers have tried to temper their expectations.

Mr Chhem says the villagers do realise that the returns they are getting from the experimental crops won't necessarily be achieved by farmers, especially since the researchers are using fertiliser.

The villagers are still nervous about the cost of fertiliser and are still waiting to be convinced that their returns will repay the investment.

But generally, Mr Chhem says the village's experience with IR66 has made them value knowledge: "We know that if our knowledge is increased, then eventually our prosperity will also increase," he says.

The same sentiment is echoed down the hill in a lowland farming system in the village of Tuol Thkov, where farmer Mr Ul Seang says the sole reason he has allowed some of his land to be used for trials is because of the knowledge he will gain from his involvement.

"Before, I knew nothing about fertilisers. Now I am starting to understand and I can see the results," he says.

Mr Seang says that as soon as the project establishes just what crop options the district has, his ambition is to progress from one rice crop a year to a rotation of two or three different crops.

Trapping success: farmers using the trap barrier system are not only reporting fewer rats but also yield increases of up to 70 percent**.**
Inset photo: CSIRO

GOOD NEIGHBOURS KEY TO WAR ON RATS

PROJECT:
ASEM/2000/007 Farmer-based adaptive rodent management, extension and research system for Cambodia

Contact:
ACIAR, Dr Ken Menz, Research Program Manager, Agricultural Systems Economics and Management, +61 2 6217 0500, *menz@aciar.gov.au*

Building on previous ACIAR work on rodent control in South-East Asia, the 'farmer-based rodent management' project in Cambodia has been achieving some spectacular results in village trials. The 'trap barrier system' (TBS) that lures and captures rats from the surrounding countryside before the main rice crops mature, is highlighting the scale of the rat problem and the significant yield lifts that are possible when rat numbers are reduced.

Under the system, a small rice crop – about 25 metres square – is sown early and inside a low plastic fence, or barrier, that is surrounded by a water filled moat. Submerged earthen 'bridges' in the moat lead to gaps in the fence, which are entrances to multiple-capture live rat traps.

The system works by exploiting the link between the growth of the rice crop and the breeding biology of the two ricefield rats (*Rattus argentiventer* and *R. losea*).

During an earlier ACIAR-supported project in Indonesia, Dr Grant Singleton from CSIRO Sustainable Ecosystems explained that breeding in ricefield rats appears to be triggered by the maturation of the rice plant itself, with females entering oestrous one to two weeks prior to maximum tillering. By the time the rice is ready for harvesting, a female may have had three litters and up to 40 offspring. This means it is crucial that females are removed from the population before or during the breeding season.

A TBS system uses an early-planted rice crop, established two to three weeks before the main crop, as a lure. These systems start catching rats while the surrounding (main) crop is at its milky (grain formation) stage, and if the system is working the number of captures drops away after this.

In Cambodia's Kampong Cham province where the system is being trialled, farmers are not only capturing a large number of rats, but are subsequently reporting yield increases of up to 70 percent in their main crops. The increased farm resources provided by such yield increases is also making farmers much more receptive to CARDI's efforts to encourage lowland farmers to intensify their production by double-cropping.

However, the drawback to the system is it needs a community-wide commitment. A 25 metre square trap will protect about 10 hectares. Because rats are mobile, travelling up to half a kilometre a night in search of food, there needs to be a network of appropriately spaced trap crops.

This means a whole community has to be committed to the concept, something which project leader (and deputy director) at CARDI, Ms Chan Phaloeun, says is the biggest challenge. "We've had lots of meetings to explain how the system works and why it needs everyone, but we find we are still learning how and why farmers think their way through these decisions. A farmer won't put in a trap if he thinks it will benefit a neighbour more than himself."

Because Cambodian farms are small this is inevitable. One trap for a 10 hectare area would mean one farmer providing the land and being responsible for the cost and maintenance, for the benefit of perhaps another five or six farms.

Phaloeun says the project has consequently become a challenging extension exercise. Whole communities have to be educated about rat biology and shown the extent and cost of rat damage. Once a community is clear about the issue, and can agree on the need to take action, then it becomes easier for a decision to share the costs of setting up and maintaining the trap units as a community exercise.

However, even that is only part of the answer. Besides trapping, the CSIRO rodent research team involved in the earlier work in Indonesia and Vietnam found the system's effectiveness was considerably improved by periodically collecting rats from their source habitats, by increasing general hygiene around villages and by synchronising cropping.

They found that if farmers planted their crops at different times, the rodent breeding cycle is effectively lengthened as the animals move from field to field and numbers can explode.

On the other hand, the benefits have been significant in districts where the TBS is well managed. Aside from increased crop yields, there have been ecological and health gains where control methods, such as poisons, have stopped being used.

LIFE SUPPORT

2004 IS THE INTERNATIONAL YEAR OF RICE, AN EVENT DRAWING ATTENTION TO THE CONTINUING NEED FOR RESEARCH TO SUSTAINABLY LIFT RICE PRODUCTION. **JANET LAWRENCE** REPORTS ON HOW ACIAR-FUNDED RESEARCH CONTRIBUTES TO THIS QUEST.

ACIAR has long supported rice research in developing countries through its close relationship with the Philippines-based International Rice Research Institute (IRRI). This support continues through financial contributions to IRRI's core programs (currently $A850,000 a year) and through funding projects in which IRRI is a research partner.

IRRI played a key role in the Green Revolution, with the development and release of new short-season, high-yielding rice varieties, and continues to provide improved lines to meet specific growing conditions around the world.

Much of the gains from the Green Revolution were made on the more prospective well-watered parts of Asia. In deciding where to put its own research funds, ACIAR places emphasis on peripheral regions where many marginalised people are farming poor soils and contend with uncertain rainfall and pests and disease.

Current and past ACIAR-funded research includes:

- breeding and selecting better rice varieties for particular cropping conditions;
- improving soil fertility and nutrition for farming systems that include rice – either alone, or in rotation with legumes, wheat or other cereals;
- improving water use in rice-based cropping;
- better weed management; and
- better pest and disease management during growth.

Other rice-related topics that have received ACIAR sponsorship are:

- nutrient enrichment of rice;
- improving storage systems to reduce postharvest grain losses;
- monitoring postharvest grain quality and food safety; and
- grain marketing policy and trade.

Key research issues for improving the global rice harvest are:

1. Increasing rice yields. These can fluctuate dramatically when plants are affected by disease, weeds, pests or climatic variations. The main research strategy is

Green Revolutionary: former principal plant breeder at IRRI Dr Gurdev Khush

There are four main types of rice-growing environments/conditions.

UPLAND RICE is grown on level to steeply sloping fields, with rarely flooded, aerobic soil. Rice is direct-seeded on dry, ploughed soil or dibbled in wet, non-puddled soil.

RAINFED LOWLAND RICE grows on level to slightly sloping, bunded fields (where a low ridge of soil separates fields, usually along the lowest contour), with noncontinuous flooding of variable depth and duration. Rice varieties adapted to the anaerobic environment are transplanted in puddled soil or direct seeded on puddled or ploughed dry soil. In the growing season soil can alternate between aerobic and anaerobic states.

IRRIGATED RICE is grown on levelled, bunded fields with water control, and the rice is transplanted or direct-seeded in puddled soil. Fields are shallow flooded and soil is anaerobic soil during crop growth.

FLOOD-PRONE RICE is grown on level to slightly sloping or depressed fields, and plants are subjected to more than 10 consecutive days of medium to very deep flooding (50cm to more than 300cm) during crop growth. Rice is transplanted in puddled soil or direct-seeded on ploughed dry soil, aerobic to anaerobic soil, and may suffer from soil salinity in tidal areas.

▶ to better match rice varieties with growing conditions. Modern varieties suited to their particular growing conditions produce higher yields, but many small farmers still use poorly suited varieties.

Researchers have adopted two main approaches – to use hybrids (combining the desired features from two varieties), or to test biotechnology applications for improved breeds (such as the use of molecular markers to identify desirable traits).

A sustained research effort is under way to develop apomictic hybrid rice, allowing new high-yielding hybrids to be reproduced without the need for male and female crossing. This overcomes the high cost and inflexibility of hybrid seed production. Apomixis is the naturally occurring ability of some plant species to reproduce asexually through seeds that lead to inheritance of genes exclusively from the mother – meaning plants growing from these seeds are identical to the mother plant.

2. Water use and the potential impacts of water shortages. Researchers are seeking varieties that use less water to achieve the same or greater yields. This is an urgent priority because Asia has a looming water crisis. Other projects are studying rainfed rice (around 18 percent of global production), which is susceptible to drought. The need is for drought-tolerant varieties that also have higher yields.

Related to these initiatives is a move to develop agro-ecological maps, combining information on rainfall, soil types and water balance (groundwater etc.) to determine the most suitable rice growing locations.

3. Increased nitrogen efficiency. Nitrogen (N) is essential for plant growth. N fertilisers have been used in Asia since the mid-1960s where they have accounted for about 24 percent of production increases. More than 20 percent of all N fertilisers produced worldwide are applied to rice fields in Asia. Nitrogen absorption depends on the rice variety and the environment, and ACIAR has funded research to lift nitrogen-use efficiency through the timing, rate and methods of fertiliser application.

ACIAR has also devoted considerable funding towards the introduction of nitrogen-fixing legumes into the cropping system as an affordable way to lift N levels.

4. Pests, diseases and weeds. Many avenues of research have sought to control rodents. Farmers have traditionally used poisons and traps, with limited success. Researchers have identified the need to break rodent population cycles, and have had success with the trap barrier system for rats in the ricefield (*see page 10*).

Scientists aim to control some diseases through developing biotechnology applications that introduce disease-resistant genes.

One project has gathered a body of information on rice disorders of all sorts (growth stresses, nutrient disorders, pests, diseases,) and incorporated it into computer-based diagnostic tools called *Rice Doctor*, which gives anyone needing to solve these problems a comprehensive source of information and problem diagnosis.

Weeds also constrain production by out-competing rice plants, especially in the establishment phase. One approach is to attack weeds with bioherbicides (natural enemies such as fungus diseases), which are safer than traditional herbicides that can leave behind dangerous residues. Also, weeds can become herbicide-resistant.

A holistic approach

ACIAR takes a holistic approach to rice research, with projects spanning everything from soil preparation to seed selection, through the whole cropping sequence to after-harvest quality and marketing. One project has sought to increase the micronutrient levels of rice to provide extra vitamins and minerals to people who depend on rice for most of their nourishment.

ACIAR research is bringing particular benefit to the cropping systems of Laos and Cambodia. Scientists are introducing plant breeding strategies for lowland rice, intensifying rice-based cropping systems in rainfed lowlands, developing direct seeding technology, increasing productivity of dry-season irrigated rice, and developing agro-ecological maps for Laos. The research should also benefit Australian ricegrowers.

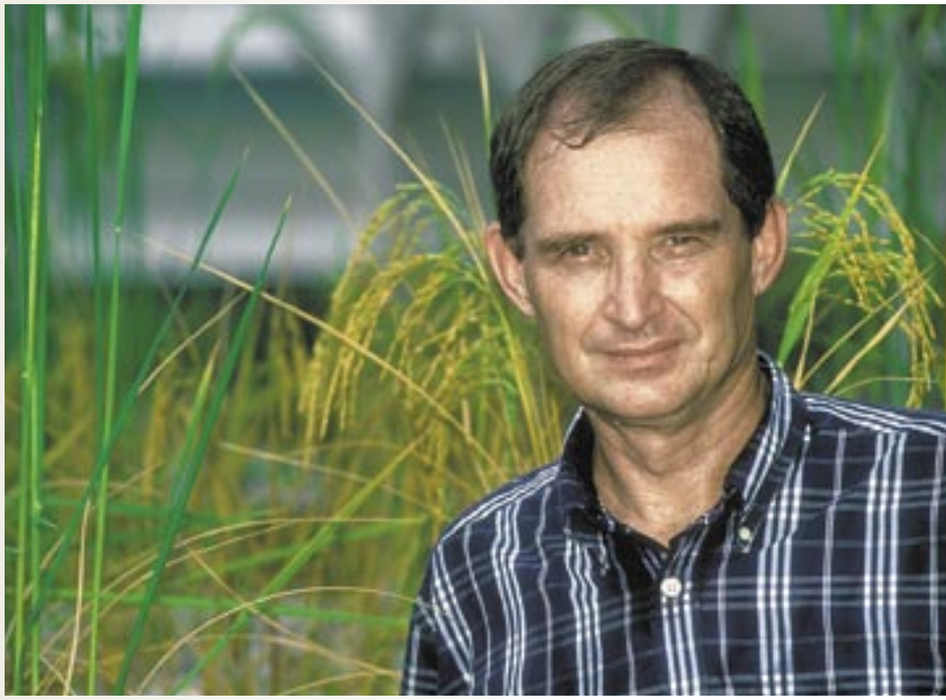
Identification of suitable rice varieties for drought-prone environments in Cambodia and Laos was possible with methods developed in previous ACIAR projects. Drought-resistant lines identified are being used in field trials to develop new cultivars with good adaptation to rainfed lowland environments and high potential yields under irrigated conditions.

Similar work on rice and other crops has taken place in East Timor. In the Seeds of Life project, ACIAR has combined with five CGIAR centres, government and relief agencies to establish a project to assess a host of varieties for local growing conditions. Scientists and local farmers are now working together to run on-farm trials of selected varieties of rice and five other crops.

Saving water

Demonstration of the water-saving potential of alternative irrigation technologies and conditions for their ▶ PAGE 14

THE MOST IMPORTANT FOOD IN THE WORLD – AND WE NEED MORE



Integral role: Dr Harry Nesbitt received an Order of Australia for his role in rebuilding Cambodia's rice industry.

BY **ADAM BARCLAY**, AUSTRALIAN YOUTH AMBASSADOR FOR DEVELOPMENT ASSIGNED TO THE INTERNATIONAL RICE RESEARCH INSTITUTE (IRRI).

It would be fair to say that many – probably a large majority – of Australians do not really appreciate the global importance of rice. Many of us tend to think of rice as the stuff we eat a couple of times a week with a curry or stir-fry. We are lucky, living in a country where most can afford a diverse range of nutritious food.

But for billions of people – almost half the world's population – rice is much, much more. It is the staple they eat with every meal. There are 250 million rice farms across Asia; most of these are subsistence farms of less than one hectare. Rice is central to cultures, to traditions, and it provides more 'employment' than any other industry. Rice farming has been called "the single most important economic activity on earth."

For the poor – 600 million in rice-producing Asia who live on less than $US1 per day and many more surviving too close to this line – rice is the source of most of their energy and their biggest single expense. The average Bangladeshi, for example, receives from rice almost 80 percent of the calories and two-thirds of the protein that he or she consumes.

In this light, the need for rice research becomes clear. Since it was founded in 1960, the International Rice Research Institute (IRRI) has performed research into rice production and management issues that have arguably saved millions from starvation. And while there is currently enough rice worldwide (although it still does not find its way to everyone who needs it), the rice-consuming population is growing faster than production.

At the same time, urbanisation and environmental destruction are reducing the amount of land available for rice, and there is increased competition for the water needed to grow it. A recent IRRI-led study has shown that global warming may significantly stunt rice production. Also, hundreds of millions of rice-dependent people suffer debilitating malnutrition, and efforts to boost the amount of essential vitamins and minerals in rice are under way.

How, then, does Australia fit into the picture? For a start, Australia exports most of the rice it grows, so any advances in production, such as improved varieties or better management practices, are good for the country.

And Australians around the world are helping to improve the lives and livelihoods of the rice-producing and rice-consuming poor. Noel Magor managed the recently concluded Poverty Elimination Through Rice Research Assistance program that administered 45 individual projects in Bangladesh.

Harry Nesbitt was last year honoured as a member of the Order of Australia for his work in re-establishing Cambodia's war-ravaged rice industry as leader of the Cambodia-IRRI-Australia Project. When the project began: "… there was just no information anywhere on the constraints to rice production in Cambodia – soils, environmental and social factors such as gender issues," recalls Dr Nesbitt. "We had to start from scratch and expand the program to include soil specialists, agricultural engineers and sociologists."

More Australians are playing an integral role in reviving agriculture in another war-ravaged country – East Timor. IRRI is a partner in the Seeds of Life project, responsible for introducing improved staple food varieties, including re-establishing the country's rice farms.

Melissa Fitzgerald has just joined IRRI to set up and lead the institute's new Grain Quality and Nutrition Research Center, which will help ensure that rice breeders and farmers alike will have access to grain with the best characteristics for local production and consumption. "You can have the highest yielding, or most disease resistant rice in the world, but research institutes ignore grain quality at their peril – if it isn't palatable, consumers won't eat it and farmers won't grow it," says Dr Fitzgerald.

The CSIRO's Grant Singleton has worked with Filipino scientists to "build a better rat trap" and help stem destructive rodent damage in the 2000-year-old World Heritage-listed rice terraces in the northern Philippines.

The Australian Government, through ACIAR, has been a key supporter of rice research in general and IRRI in particular. Australia is building partnerships, including with IRRI, to achieve the goal of all in Asia having access to affordable, nutritious rice, and sustainable production with minimal environmental impact.

As Australia is inextricably linked with Asia, a food secure region is in everybody's interests.

▶ FROM PAGE 12

adoption has helped to determine how, when and to what extent farm practices affect water savings elsewhere. Models being developed will help evaluate the impact of on-farm and regional water management options.

Trials to grow rice in rotation with other crops using a system of permanent raised beds have recently shown promising results in South Asia and Australia. Crops are grown on raised mounds or beds of earth, where irrigation water is only supplied to inter-bed furrows. Rice plants on the beds have a portion of their root systems in unsaturated soil. This allows the beds to be permanent, minimising changes in fields between crop rotations.

Zero-till seeding of rice into wheat residue and of wheat into rice residue on raised beds does not disturb the soil in the same way as ploughing. The use of a drill that penetrates the soil and plants the seeds in the previous crop's residue has proven effective. Funding from a small ACIAR project has helped Indian manufacturers to develop prototype drills that can sow into residue.

Scientists have applied simulation modelling to show that a mungbean crop can be added into a rice–wheat rotation. The findings have led to recommendations of earlier sowing for rice and wheat, which would enable earlier sowing of mungbean and lead to larger, more reliable, mungbean yields as well as more reliable rice and wheat yields.

In the Mekong Delta in southern Vietnam, brackish water floods the rice fields near the lower reaches of the river during the dry season, hampering efforts to grow a second rice crop. Farmers have adapted by growing shrimp in the rice paddies during this time. ACIAR studies have found answers to many of the problems associated with these dual enterprises, greatly assisting the expansion of rice/shrimp farming.

After the harvest

Mycotoxin or pesticide contamination of food and feedstuffs (including rice under certain conditions) is a hazard to the health of people and livestock in Vietnam and Australia. Scientists sampled a range of commodities from both countries to establish the incidence and severity of contamination. They then developed sampling protocols and field-laboratory immunoassays to detect the levels of a range of mycotoxins and commonly encountered pesticides.

Phosphine is the major fumigant for stored grains in China, Vietnam and Australia, due to its low cost, ease of use and acceptance as a residue-free treatment. However, growing resistance to phosphine by grain pests threatens its continued use. Scientists have identified technical innovations to enhance the efficacy of phosphine and have also characterised phosphine resistance in new strains of major pests.

In West Bengal, drying of rice (and maize) relied on systems that were inefficient in terms of energy use and grain quality and did not provide the service needed to modernise the region's grain industries. Attention to moisture removal during storage was inadequate, and quality deteriorated during storage and transport. A research team is working to scope, develop, test and disseminate improved two-stage systems for drying grain, while enhancing local capacity to design, manufacture and manage grain-drying systems that will benefit smallholders in West Bengal.

In Thailand, the development of a fluidised bed dryer for grains, including rice, has significantly reduced post-harvest losses. Rice and other grains are traditionally dried using a variety of methods, including spreading the grain out on roads to dry in the sun. The resulting losses from disease, contamination and other factors is high.

ACIAR-supported research over more than a decade has resulted in the development of a fluidised bed dryer. Further developments included an aeration system. The dryer is economical to run and can handle large quantities of grain.

Thailand adopted fluidised bed dryers in 1995. Thai rice millers have bought more than 50 dryers from the Rice Engineering Supply Company in Bangkok, and about one million tonnes of the 23-million-tonne Thai rice crop are now dried using fluidised beds. Up to 30 of the mills with fluidised bed driers have also adopted the aeration technology emerging from the project. An annual rate of return of 27 percent has been calculated for the project with forecast benefits to 2020 estimated to total $A9.4 million.

Freeing up the markets

Because China's rice production is concentrated in certain parts of the country, studies of the internal marketing of rice in China are helping to open up trade between different regions. Economic liberalisation in recent years has given producers new opportunities to choose what to grow and how to sell it. ACIAR has funded studies that have contributed to the development of new grain market policy.

The goal was to help China achieve the benefits of free markets while continuing to meet national grain supply goals. Researchers contributed advice to initiate the transformation of unwieldy state-based grain bureaus into efficient commercial organisations.

Australia through ACIAR continues to foster rice research at a time when support from other avenues is in decline. According to Dr Keijiro Otsuka, chairman of IRRI's Board of Trustees, lack of development of the rice sector is a threat to regional security: "Research is one of the few proven avenues for improving the lives of rice farmers and consumers alike," he said on a recent visit to Australia.

This is reason enough for ACIAR to continue to show leadership in an issue that is vital to the future of the Asian region.

'RESEARCH IS ONE OF THE FEW PROVEN AVENUES FOR IMPROVING THE LIVES OF RICE FARMERS AND CONSUMERS ALIKE'

A T(R)ICKY PROBLEM SOLVED

Livestock represent a valuable resource for poor farmers throughout Asia, as a source of draft power, through the sale of young animals and for food security. Animal diseases are a constant threat to the health of livestock. Developing improved testing, monitoring and controls for animal health is the focus of a number of ACIAR-supported projects.

Improved returns: projects benefit smallholders in the Philippines. **Photo: ACIAR**

Solving the mystery of what tick-borne diseases of cattle are present in the Philippines and their impact on the country's 2.4 million cattle has been the subject of investigations by researchers from that country and Australia.

In the Philippines, as elsewhere, ticks can be a nuisance. But the real problem is the diseases they can transmit with a single bite. In susceptible cattle, tick-borne diseases can cause dramatic losses in productivity and frequently death.

The impact of tick-borne diseases in the Philippines has not been as severe as elsewhere due to the inherent resistance of local breeds. That situation could change rapidly as the Philippine government embarks on a program to build more profitable beef and dairy industries through importation of better breeding stock.

But knowing where the diseases are present and how prevalent they are, especially when acute symptoms are rare in local cattle, is difficult. Developing the capacity for accurate testing and diagnosis is an urgent priority to support this expansion.

Helping speed up this process has been the focus of ACIAR-supported research by the Queensland Department of Primary Industries and Fisheries and the Bureau of Animal Health in the Philippines.

Prior to this research the types of tick-borne diseases, their distribution and prevalence were not known. The two diseases of major concern to Philippine authorities are babesiosis and anaplasmosis, collectively known as tick fever.

By introducing appropriate testing, survey methodologies and training of local researchers to the Philippines, these unknowns have all been addressed.

Centres of expertise in the diagnosis and control of tick fever have been developed in the key laboratories in Manila and Davao that service the major cattle producing and cattle importing areas in the north and south of the Philippines.

These laboratories are now recognised reference centres for the rest of the country and models for establishing similar expertise in Regional Animal Disease Diagnostic Laboratories (RADDL) throughout the Philippines.

The completion of serological surveys has established that both diseases occur throughout the country. Serological tests for babesiosis and anaplasmosis are now in routine use in the Philippines, and DNA-based tests capable of differentiating between Australian and Philippine disease strains have been developed.

These research outcomes are vital in the ongoing development of a more substantial livestock industry in the Philippines, an important Government initiative that stands to benefit smallholder farmers particularly.

The greater the profitability of livestock industries, both through diversification such as into dairy cattle, and through healthier more productive cattle, the greater the opportunities for smallholders to reap increased returns.

The project has also contributed to the smooth operation of the live cattle trade between Australia and the Philippines, an outcome that is already paying dividends.

The project has shown that the introduction of Australian strains of *Babesia* and *Anaplasma* in imported cattle is not a problem, as the same parasites are already present throughout the Philippines.

The result should be an improved trading relationship between Australia and the Philippines with less likelihood of trade disputes as a result of tick fever outbreaks in imported cattle.

PROJECT:
AS2/2000/098 Bovine babesiosis and anaplasmosis in the Philippines: developing a research and diagnostic capability

Contact:
ACIAR, Dr Bill Winter, Research Program Manager, Animal Sciences 2,
+61 2 6217 0500,
winter@aciar.gov.au

BID TO BEAT PARASITE GOES TO THE FARM

Control of one of South-East Asia's most pervasive livestock diseases, fasciolosis, is about to enter a new phase as researchers begin to wrestle with the issue of translating science into new stock management practices on-farm.

Studies in Indonesia, the Philippines and Cambodia in recent years have brought the mystery condition in from the dark, in terms of understanding its epidemiology, but scientists say the next phase of the project – control and farm management – may be the biggest challenge.

Research has revealed that more than 50 percent of cattle and buffaloes are infected with the fasciolosis parasite, and the symptoms – weight loss, diarrhorea and animals becoming too weak to work, to the point that some die – have been prevalent for so long that farmers will be hard to convince that there is an answer.

In Cambodia, the research into the epidemiology as well as the coming work on developing effective extension services has been led by Dr Suon Sothoeun, who is now deputy director of the Department of Animal Health and Production (DAHP).

Fasciolosis was the subject of Dr Sothoeun's PhD in 1990, and it was a meeting four years later with ACIAR's research program manager, Dr John Copland, and Dr Bruce Copeman from James Cook University that led to Cambodia's involvement in the 1998-2002 project to fully establish the disease's epidemiology.

Dr Sothoeun says fasciolosis is caused by the parasitic liver fluke *Fasciola gigantica* and has now been shown to be the most important parasitic disease of cattle and buffalo in the humid wet tropics.

Aside from making animals too weak to pull a plough, he says infected animals suffer serious liver damage and also become less fertile. "The average liver weighs six kilograms. The liver of an animal with fasciolosis weighs just 3.7 kilograms on average, so you can see the extent of the damage. In fact, to explain to farmers that it was a disease caused by a parasite we started showing them livers from the abattoir. We've sometimes found over 700 flukes in a single liver."

Dr Sothoeun says four years were spent building up scientists' knowledge of the epidemiology – when the animals are infected, where they are infected and how they are infected. "We learned that infections occur in specific months – from November to April-May, and there are no infections from June to October."

The initial four-year study produced several recommendations based on the following findings:

- a high prevalence (more than 50 percent);
- November to April-May being the infection period;
- the practice by farmers to sell and replace infected animals as a way of trying to stay ahead of the mystery disease;
- the significant liver damage; and
- a 50 percent drop in fertility rates. Instead of producing an offspring every year, inter-cowing among infected animals stretched out to 24 to 25 months.

These factors have led to new livestock management recommendations that now have to be incorporated into effective extension and education programs.

Dr Sothoeun says this will need further research, but in the meantime researchers have developed a proposed control calendar. The calendar is based on the knowledge that infection peaks in April and is slightly different in three distinct categories of grazing:

- grazing out in the fields;

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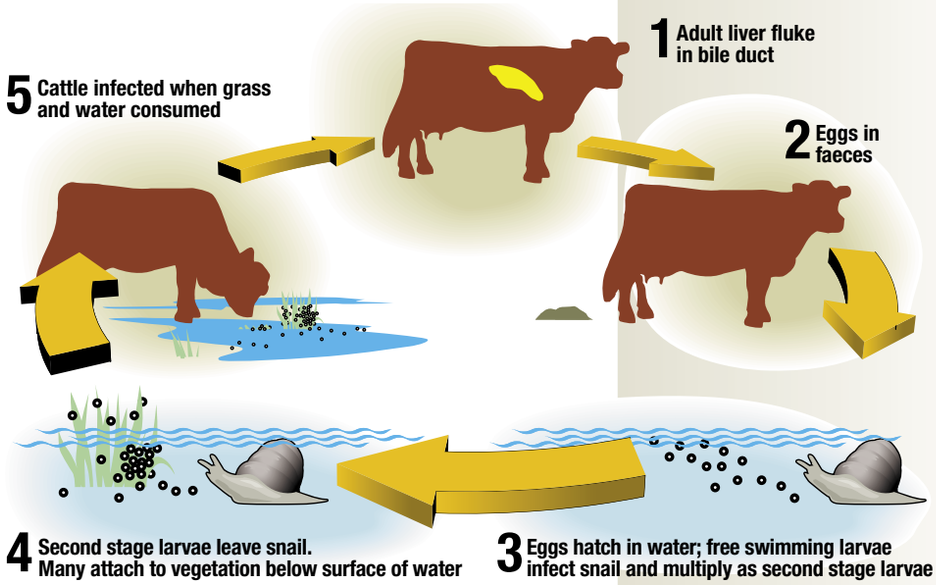
SUCCESS WILL BE NO FLUKE



By JANET LAWRENCE

A "fluke" can be a lucky accident or coincidence. Another Oxford Dictionary definition of fluke is "any parasitic flatworm of the Class Digenea or Monogenea, including liver flukes and blood flukes".

For the team of scientists dedicated to the study of the large parasitic flatworm *Fasciola gigantica*, success has been no lucky accident. It has come from years of dedicated, painstaking investigation to uncover the life cycle of this parasite and to determine ways to control the disease fasciolosis that results from its invasion of cattle and buffalo in the wet tropics.

Fasciolosis causes huge losses in animal production. The scientists involved in early ACIAR research in Indonesia in the mid-1980s examined the effect of the condition on the work output of large ruminants in Indonesia. They concluded that its presence caused up to $A100 million annual loss in production.

Infected animals are anaemic and, compared to healthy counterparts, are slow growing and achieve a lower final weight and size. As well as lowering meat and milk production, such animals produce fewer calves. They also have reduced working capacity, which is especially significant in countries where farmers rely on cattle and buffalo to cultivate the land. But when a disease is so common and unspectacular, farmers have a certain resignation about it and the poor condition of animals is considered normal.

Indonesian and Australian scientists were looking for ways to lift farm productivity and improve the lot of the smallholder, and recognised that reducing the effects of fasciolosis would have major benefits. They set out to unravel the life cycle of the fluke, which spends its adult life in the body of the animal and an intermediate phase in a water snail. This early work was reported by Robert Lehane in *Partners* No. 11 in 1998 (see chart, right).

The team, led by Dr Bruce Copeman from James Cook University and Dr Suhardono of Indonesia's Research Institute for Veterinary Science, discovered that the main source of infection for animals was recently harvested rice fields when the animals graze on the stubble.

They recognised that village rice farming provides the ideal environment for proliferation of tropical liver fluke, with a strong link between the cycle of infection and the agricultural and husbandry practices of the smallholders.

Their studies produced two promising outcomes. The first was the determination that a single dose of the medication triclabendazole dispensed to animals in July completely eliminated *Fasciola* eggs from their faeces for at least nine months. Such a straightforward treatment could have a major impact on transmission of the parasite.

The second line of research revealed that the immature phases of *Echinostoma revolutum*, a fluke that commonly infects village ducks and chickens, could aggressively displace *Fasciola gigantica* in the intermediate host snail when the two were present together. The scientists recognised the potential for an inexpensive, practical control procedure.

The knowledge gained from the Indonesian work gave new hope for control of the problem in Indonesia and other South-East Asian countries. In July 1998 a four-year ACIAR project commenced, focusing on Indonesia, the Philippines and Cambodia. The project's main purpose was to extend the work of the earlier project, developing suitable, cost-effective strategies for the control of the parasites, and combating the problem on a regional rather than country-specific basis.

In the new project, the scientists extended their study to measure benefits of control of fasciolosis. Extension to promote control of fasciolosis was also an important component of the project.

Abattoir surveys in Cambodia and the Philippines produced basic biological statistics about seasonal and regional prevalence, parasite load and host conditions. Problems associated with biological control using ducks were investigated.

Scientists had discovered that a second parasite infecting the ducks, a blood parasite called a schistosome, had a free-living stage in the water that burrowed into human skin, causing an itchy, unpleasant dermatitis – a major deterrent in the campaign to encourage farmers to keep ducks! The solution was to use village chickens instead of ducks.

The overall output of the project was to demonstrate that the application of a scientifically-based fasciolosis control program can alleviate poverty through increased animal production.

The initial impact of the research was restricted to the sites where the research took place, but animal owners who participated in the research learnt how to ▶

LIFE CYCLE OF *FASCIOLA GIGANTICA*

The tropical liver fluke's life cycle begins when worms lodged in the bile duct of an infected animal produce eggs that pass out in the faeces. The eggs hatch in water, producing free-swimming larvae that proceed to infect water snails. About six weeks later the snails deposit the larvae (cercariae) in the water of a rice field and the larvae become small cysts (known as metacercariae). These float in the water, sink into the mud or attach themselves to the stalks of the rice plants below water level. Livestock are infected when they eat the vegetation or drink the water.

No fluke: research leader Dr Suon Sothoeun.

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- grazing in areas adjacent to households; and
- grazing in the immediate household area.

It has been shown that January to April is the infection period for 'in-the-field' grazing, September to December for 'near households' and September to April for animals grazing inside household enclosures.

"So we can now recommend corresponding treatments," he says. "For in-the-field cattle, we recommend treating with triclabendazole in May when we have four months during which infection won't occur. For cattle grazing adjacent to households we are recommending albendazole in May and again in July. Both triclabendazole and albendazole are oral treatments.

"For cattle around households we are recommending dovenil by injection, also in May and July."

However, before farmers will accept the cost of these controls they will need to fully understand the disease and the costs they are already incurring because of the disease.

Dr Sothoeun says a cost-benefit study will be an essential part of the new program. "We have to prove to farmers and to the government that fasciolosis is the problem that we say it is so that we can get government support for a national control program.

"We also have to test farmers attitudes to the controls we are proposing and to determine which extension methods will be the most effective – farmer meetings, or TV/radio?"

Dr Sothoeun says this next phase will be an interesting challenge – turning science into on-farm change.

ACIAR support is continuing through this two-year small project in Cambodia. Researchers will refine and validate a GIS-based risk model for fasciolosis in that country, and also implement and evaluate an extension program.

This will involve production of extension materials in the Khmer language. Dr Lee Skerratt is the Australian project leader, and Tum Sothyra, a John Allwright Scholar, is playing a pivotal role in the project's implementation in Cambodia.

This new project will help fulfill the initial research intentions of problem solving, capacity building and extension to farmers.

PROJECT:

AS1/2002/099 Development of a model for the control of fasciolosis in cattle and buffaloes in the Kingdom of Cambodia

Contact:

ACIAR, Dr John Copland, Research Program Manager, Animal Sciences 1, +61 2 6217 0500, *copland@aciar.gov.au*

▶ increase the income they derived from animal production.

The scientists developed options for fasciolosis control that required minimal use of anthelmintic medications. The control program is based on the following five elements:

1. **prevent animals grazing in rice fields adjacent to a village or cattle pen for up to a month after harvest, to reduce their risk of ingesting the infective metacercariae;**
2. **feed only the top two-thirds of freshly cut rice stalks, cut 20 to 30 centimetres above ground level, to avoid feeding the metacercariae;**
3. **kill metacercariae on the lower third of the rice stalks by exposing them to sunlight for three days before feeding to cattle;**
4. **before using cattle or buffalo dung as fertiliser in rice fields, mix it with duck or chicken manure that has been naturally infected with the poultry fluke *Echinostoma revolutum*; and**
5. **treat cattle with triclabenzadole about six weeks after harvesting the second seasonal rice crop.**

These recommendations are now being made available to extension services in Indonesia, Cambodia, the Philippines and through representative networks to Vietnam, Thailand and Laos.

The extension will be assisted by the availability of pamphlets and other material and the production of a laboratory manual that will provide technical support for researchers and extension workers. Publishing a monograph will complement the publication of research results in scientific journals and will make all the results of this project available in one convenient document.

Three scientists associated with the research received ACIAR John Allwright Fellowships to undertake postgraduate studies in Australia. Elizabeth Molina is undertaking pathology studies on cattle and buffaloes in the Philippines. Her work will help to build up a comparative picture of the fluke resistance in these species. The study is being completed by analysis of the samples at James Cook University.

Another John Allwright Scholar studying at James Cook University, Tum Sothyra, has used Geographic Information Systems (GIS) technology to construct a map showing the risk of fasciolosis in Cambodia. GIS technology holds the promise of saving resources through better targeting the high-risk areas for application of control measures.

The third scholar, Eny Martindah, is a PhD candidate at the University of Queensland, studying extension theory based on control of fasciolosis in Indonesia.

The stated aim of the project was to develop extension programs to introduce the control measures in South-East Asian countries. Project reviewers found that a great deal of trust had been established between extension workers and the animal owners. It was therefore the basis for successful fasciolosis control, and also an opportunity to introduce other animal health measures.

A fasciolosis control network of researchers is now well established, giving a region-wide perspective to the research effort. For instance, the project supported an international workshop to standardise laboratory procedures for research into fasciolosis.

PRACTICAL TOOLS FOR SURVEYING ANIMAL DISEASES

When thinking of toolboxes, images of spanners, wrenches and screwdrivers spring to mind, but for many scientists throughout Asia and the Pacific the image they have may be very different.

Chances are that when the term toolbox is mentioned they think of one of two books: the *Survey Toolbox for Livestock Diseases* and the *Survey Toolbox for Aquatic Animal Diseases*. Both books introduce readers to methods for surveillance of animal diseases, developed specifically for developing country contexts. At the beginning of each is a guide offering two options.

For those already familiar with animal health surveillance, there is the option to carry out a survey, including for disease prevalence, impacts on production, disease incidence and detection.

For workers unfamiliar with this methodology, the option to learn more exists, directing the reader to the appropriate chapters, prior to embarking on a survey. Both books also include software support on CD-ROM.

The surveillance techniques behind the *Survey Toolbox for Livestock Diseases* were developed during two ACIAR projects on animal health and diseases, the first in Thailand between 1994 and 1996, the second in Laos from 1996 to 1998. The author of both *Toolboxes*, Angus Cameron, was involved in both projects as an Australian Volunteers International (then known as Australia's Overseas Service Bureau).

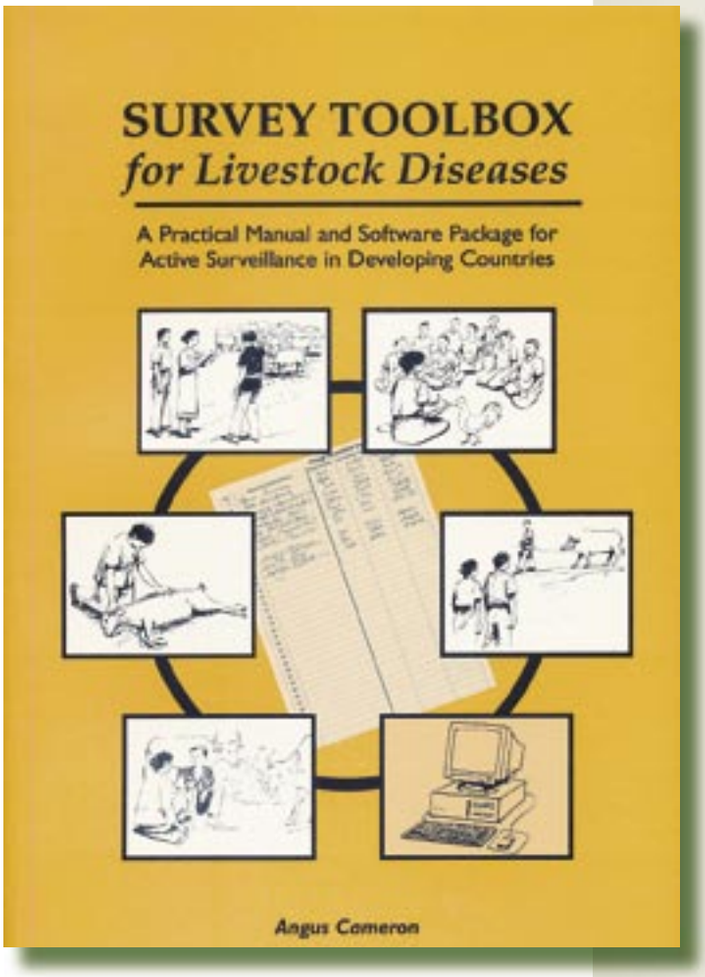
Angus worked in the mid-1990s with the ACIAR project at the Northern Veterinary Research and Diagnostic Centre in Lampang, northern Thailand. An epidemiologist, Angus joined a team working to better diagnose, track and manage stock diseases in both Thailand and Australia.

Animal health officers need accurate information on the diseases, their spread and their impact to ensure the effectiveness of the control programs that are in place.

During his time in Thailand, Angus worked on new epidemiological techniques suited to developing countries. This included developing practical, more affordable survey techniques that are appropriate for Thailand and other developing countries.

Angus recalls the challenges and rewards of working in Thailand at the time: "I was often astounded by the remoteness and beauty of villages that we surveyed. Catching a glimpse of the lives of these farmers was a privilege, and their hospitality at times overwhelming – too much of the local rice whiskey at lunchtime makes it difficult to collect blood from angry buffaloes in the afternoon."

He then moved on to Laos to take up a second posting with the OSB. His research led to the awarding of a PhD from the University of Queensland.



Angus used the knowledge and skills gained from working in Thailand, Laos and other Asian countries to write about active surveillance for livestock diseases, published as the *Survey Toolbox for Livestock Diseases*.

It has been widely acclaimed and is now available in several languages.

"The books are designed to be easily understood and practical. I tried to distil key information, offer relevant examples and illustrations. One of my greatest satisfactions is seeing the completed translations (for instance in Spanish, Japanese, Lao and Indonesian), with much of the work done voluntarily by enthusiastic epidemiologists in different countries."

The FAO has adopted it as a reference publication.

Today Angus is a director of AusVet Animal Health Services, a specialist epidemiology consulting company, providing services to clients in Australia and internationally, working across a wide range of species, including livestock, aquatic animals, wildlife, plant and human health.

Angus continues to be involved with disease control authorities in South-East Asia. He has recently been working with the Thai Department of Fisheries on a surveillance system for Thailand using the *Toolbox* as a resource, and in the Philippines conducting training on foot and mouth disease control and surveillance, again using the *Toolbox*.

'CATCHING A GLIMPSE OF THE LIVES OF THESE FARMERS WAS A PRIVILEGE.'

SHIFTING THE GOALS

By BRAD COLLIS

In the villages of the Lao People's Democratic Republic (Laos) cattle, buffaloes and pigs have always been central to farming life; as a source of meat, income in times of crisis when crops fail, and as tractor power for ploughs. However, livestock production has rarely extended beyond one or two large animals – a cow, buffalo or pig – for a typical village household because of disease and limited feed.

As lush and green as the uplands might look, there is little that is nutritious, or even edible, for large herbivores, and the forest has traditionally been the animals' sole source of feed.

Unfortunately for farmers, the free-ranging animals themselves often become feed – for tigers, leopards and other farmers. As many as half of them eventually disappear.

The practice of letting livestock graze in the forests has, however, been a comfortable fit with shifting cultivation. This is the traditional method of cropping; to clear a patch of forest, cultivate it with maize or rice for two or three years until the soil nutrients have been exhausted, and then move on. The cultivated area is then allowed to revegetate in what is often a long period of fallow – usually a decade or more.

Shifting cultivation, however, is slowly being phased out as more and more villages adopt a research and extension program aimed at increasing livestock production and livelihood security through the dedicated cultivation of fodder crops.

These crops – tropical grasses and legumes – provide a daily source of feed that allows more intensive and secure livestock raising, which is showing signs of breaking the poverty cycle and laying the foundations for sustainable village economies.

The Forages and Livestock Systems Project (FLSP) is allowing households to run more livestock that can also be housed close to or in the village where their security, conditioning and health can be better managed.

Further, the manure from housed or tethered livestock is a readily available fertiliser supply, allowing food crops to be stabilised on land closer to the village. A side benefit from the cessation of shifting cultivation is a more permanent recovery for forest ecosystems.

The FLSP is being run by the International Center for Tropical Agriculture (CIAT) with research support from ACIAR, and funded by AusAID and the Asian Development Bank.

Project director Dr Peter Horne says livestock were identified as the ideal livelihood activity for Lao farmers because the market is stable, they provide manure for crops, and they are a means of capital accumulation.

The flipside to this opportunity and reliance is the need to keep animals healthy. They represent a large capital investment and keeping them alive under traditional management systems has been a constant struggle.

In a survey in 2000, almost three-quarters ▶ PAGE 22

‘BUYING SKINNY, SELLING FAT’

Farmer Mr Va Yer Lao from the small upland village of Xang in Laos is becoming somewhat of an entrepreneur since he and his neighbours started setting aside land for planting forage crops.

The ready access to feed, and to an animal that is no longer let loose to feed itself in the surrounding forest, is allowing him to “buy skinny and sell fat” and for a handsome profit.

Mr Va Yer Lao has established a significant new income stream for his household by buying under-nourished buffaloes from the market, bringing them home to fatten, putting them to work when it is time to plough, and then selling the improved animals for substantially more than he paid for them.

He says that on average he can buy a buffalo in poor condition for about $US250, and sell it some months later after improving its condition with fresh forage for about $US320.

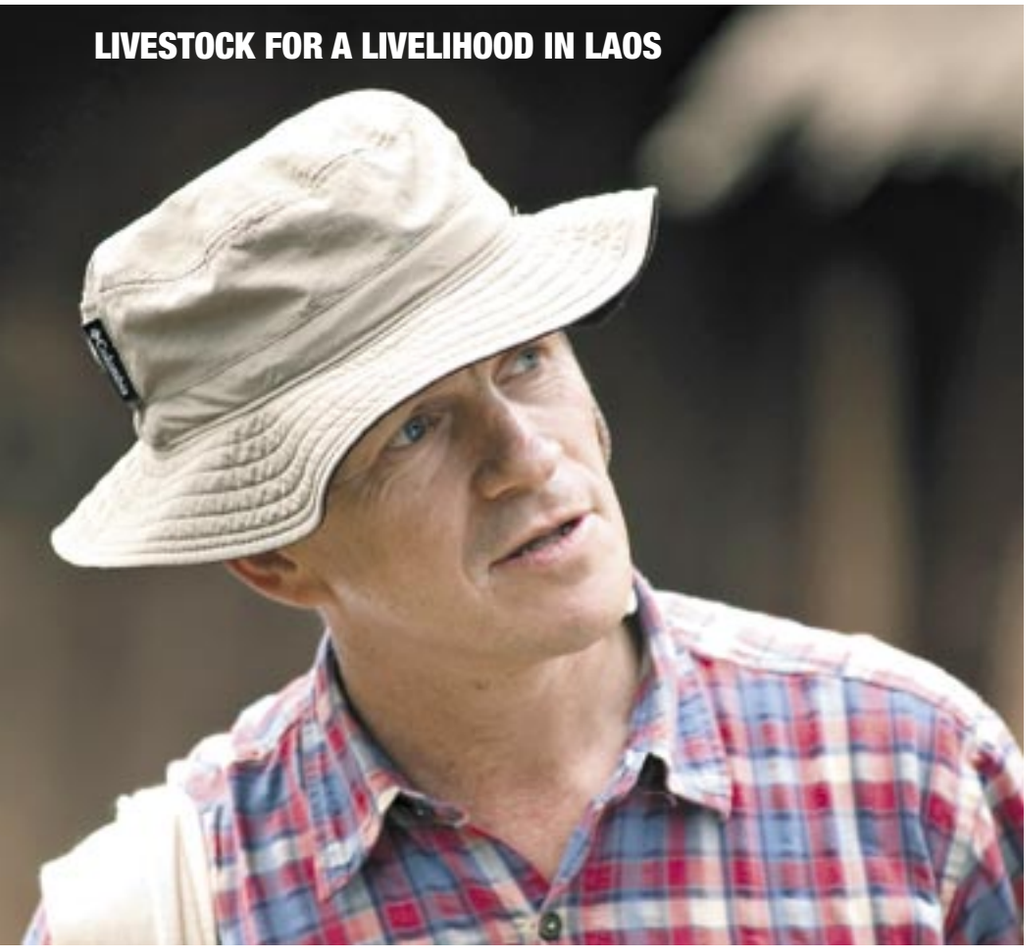
In Laos the initial outlay to buy a buffalo is a large and risky investment – more than many people would earn in a year – but a $US70 profit makes the risk worth taking. This sort of income turns subsistence farmers into farmers with the resources to dramatically lift a village’s agricultural prospects and living standards.

Mr Va Yer Lao says that planting a fodder crop means the animals can be kept closer to the village, or even in the village, making their investment more secure on several fronts. It not only allows the farmers to feed them well – up to three times a day with freshly cut grass – but to keep a closer watch on their health.

The income being generated by the resale of improved livestock also allows farmers to switch some rice land over to forage crops because they are now able to buy rice.

Mr Va Yer Lao says he and his neighbours are keen to expand their livestock production and are now determining how much land is needed year-round for them to each feed two or three cattle or buffaloes.

How much extra land they need to find will be influenced by the results of trials with improved fodder varieties, and from innovations such as mixing grasses (mostly of the grass genus *Brachiaria*) with small amounts of legumes like stylosanthes.



Changing attitudes: project director Dr Peter Horne.

▶ FROM PAGE 20

of villagers attributed livestock disease as the cause of their poverty. In 12 upland villages, farmers revealed that more than 80 percent of chickens, 50 percent of pigs and 30 to 40 percent of buffalo calves died every year from disease.

The answer, to researchers, was fairly obvious – keep the animals in the village where they can be housed, fed and managed with sound animal husbandry.

However, this is requiring a major research and extension effort, covering agronomy and sociology, because a long established way of life has to be changed. Farmers have to be convinced the change is low-risk (that the forage crops will grow), and can be achieved at low to no cost.

Peter Horne – who speaks fluent Lao – says that once farmers start growing forage and can see the benefit, it becomes possible to start gradually changing their attitudes towards livestock away from livelihood security to income generation.

He cites the example of one farmer, Mr Sing Chittapay, an 'early adopter' in Houay Hia village (Ban Houay Hia) near Luang Prabang: A 10-month-old calf sold for more than his neighbour's 12-month-old calf. His wife started feeding the legume 'Stylo' to her pigs and was able to reduce the fattening time from five to three months.

With one hectare of mixed forages, Mr Sing now runs 14 cattle, nine goats and seven pigs. He has been able to halve the area of the family's shifting cultivation and intends soon to stop altogether.

Following Mr Sing's lead, 17 of the village's 23 households are now developing market-orientated livestock systems. The forage area has expanded to more than five hectares and the shifting cultivation area has fallen from 40 to 18 hectares because of more productive paddy land that is utilising collected manure.

Peter Horne says this level of impact is significant because it is not isolated to one farmer or village, nor is it the output of model farmers who receive unsustainable levels of outside support.

He also emphasises the importance to the FLSP project of enthusiastic teams of field staff who are, for the first time, seeing that through their work they can change people's lives for the better.

"All we (CIAT) do is catalyse this process with ideas, raw technologies, mentoring and encouragement. It's a bit of a journey because you can never know where the development process is leading," he says.

"This is why small, long-term, committed, flexible projects on-the-ground are the most successful. They are nimble enough to follow the leads that development shows them and committed enough to provide the long-term mentoring that is required."

PATHWAYS OUT OF POVERTY

By BRAD COLLIS

In the gloom of a long wooden hut with a hard clay floor and hand-hewn benches, the farmers of Ban Ta take turns to offer suggestions about the coming year's priorities for themselves and for researchers.

As a community they are committed to progress. The status quo was obliterated a long time ago. These farmers are survivors of the time when B52s were dropping bombs at a rate equivalent to one payload every eight minutes for nine years.

It has made them focused on the future and on the tangible opportunities that are accruing through being innovative. They also relish being in the driver's seat. The international scientist and local extension officers in the hut are there to listen as much as to provide guidance.

If it were not for the absence of an electric light, or the posters depicting the UXOs (unexploded ordnance) still strewn across their farms and forests, it could be a farmer meeting anywhere in this era of fast-changing agriculture. The aspirations and most of the underlying issues are universal – soil, water, nutrition, disease, risk, and the perpetual pursuit of quality, price and lower costs. To this the Lao farmer grimly adds endemic poverty and the daily risk of a plough or hoe detonating a high-explosive bomb.

However, the farmers of Ban Ta, in the uplands near Xieng Khouang – home to the fabled Plain of Jars – doggedly take each day as it comes, striving little by little to advance their farms and improve their livelihoods.

In less than a single generation they have started to change a way of life that persisted for centuries. They have progressed from subsistence to sustenance to glimpses of enterprise; a steady pathway out of poverty, and importantly the changes are their own. All the technologists have done is introduce strategic alternatives to traditional practices – such as forage for improved livestock production – and let the farmers drive the future from there.

At this meeting are two government-employed district extension officers, Khampai Phommavong and Sin Phuttapanya, and Dr Peter Horne an Australian research scientist with CIAT.

The farmers tell the visitors they are making good margins from the sale of animals that are being hand-fed two to three times a day from freshly cut fodder. They also report pleasing results from incorporating sweet potatoes and legumes into animal diets. Their pigs in particular are thriving. They express an interest in learning about any new or improved forage varieties that might be in the offing.

One villager tells the extension officers that it is time the farmers learned some marketing techniques. He ▶

Emerging from the gloom: farmer Pa Heu is proud of her achievements.

is sure they could negotiate better prices from the traders who pass through the village if they had some marketing strategies.

A woman farmer, Pa Heu, says she is growing mulato (a *Brachiaria* hybrid) around her fish pond. The high soil moisture is providing a vigorous year-round forage crop. Later she proudly shows the visitors her new sweet potato plot and the buffalo that is responding so well to her hand-feeding that it is bound to boost the family's income when it is sold (and replaced by a cheaper, malnourished beast which will be similarly improved).

When asked why they decided to adopt the CIAT/AusAID project, the farmers say it is because the project is long-term; it began from a low base and offers a rational progression.

Ban Ta is just one of many villages that are participating in the Forages and Livestock Systems Project. As an example of the influence of early adopters on the wider community, Peter Horne says that since the project started in 1998 the number of farmers in Ban Ta who have changed to forage-based livestock production has increased from eight to 24, out of a total of 36 households.

The obstacle for households that have not joined the project is they simply do not own any livestock and their crops do not earn enough money to buy a buffalo or a pig.

It is a reminder of the enormous risks that the early adopters took. If they had lost their only cattle or buffalo it could have set them back for years, if not for life.

PROJECTS:

The FLSP project provides a bridge between ACIAR research projects ('Proof of Concept' projects) and larger development projects whose role is to take the kinds of impacts demonstrated by FLSP and expand them on a large scale. There are three ACIAR projects that work closely with FLSP:

AS1/2003/001 "Improved Diagnostic and Control Methodologies for Major Livestock Diseases in Lao PDR". This project does all of its field work with the network of district staff and farmers that constitute the FLSP.

ASEM/2001/107 "Accelerating the impacts of participatory research and extension on shifting cultivation farming systems in Laos". This project does all of its field work with the network of district staff and farmers that constitute the FLSP.

AS1/1998/026 "Lucerne adapted to adverse environments in China and Australia" (they have expanded to include Laos). Within Laos, this project does all of its field work with the network of district staff and farmers that constitute the FLSP. ACIAR has also funded the publication of three books in eight languages about the forage technologies and participatory research methodologies that are being used by the FLSP.

Contact:
Dr Peter Horne
Forage Agronomist and Team Leader, CIAT
p.horne@cgiar.org
See also: *www.ciat.cgiar.org/asia/forages.htm*

The forage crops being offered to Lao farmers are the result of an intensive plant breeding program that began in 1995.

From 600 accessions selected from the germplasm collection at CIAT and pre-tested to screen out deficiencies, about 150 accessions were tested at five nursery sites throughout Laos. The most promising accessions were then moved into regional nursery evaluations.

The result of this work was a small group of broadly adapted and robust forage varieties suited to the environmental conditions of the uplands in Lao PDR.

The best varieties at this stage are *Brachiaria brizantha* "Marandu", *Brachiaria* hybrid "Mulato", *Panicum maximum* "Simuang" and *Stylosanthes guianensis* "Stylo 184".

Other productive varieties but with particular uses or adaptation are the grasses *Andropogon gayanus* "Gamba", *Paspalum atratum* "Terenos" and *Setaria sphacelata* "Solander" and the legumes *Calliandra calothyrsus* "Besakih" and *Gliricidia sepium* "Retalhuleu".

FISHING FOR TOMORROW

In August, the annual Crawford Fund Parliamentary Seminar examined the issues of sustaining fish as a global food supply. Two of the presenters were ACIAR's Fisheries Research Program Manager, Mr BARNEY SMITH, and Dr GEOFF ALLAN, consultant to ACIAR's Fisheries Program and Immediate Past President of the World Aquaculture Society.

Live now, pay later: for the coastal communities of many developing countries, fishing is the only pathway out of poverty.

BARNEY SMITH:

For many coastal communities fishing is not a way of life, it is life. But the subsistence nature of fishing in these communities is changing. Rising global seafood demand is resulting in more fishing, both by commercial and village fisher folk.

For many coastal communities, fishing has become a means of creating additional income as a way out of poverty.

Long-term sustainability, of fisheries and the communities that depend on them, can get lost in the push for increased catches. Without this, developing countries, Australia and the oceans of the world all lose.

In many countries in the Asia-Pacific region a lack of resources and expertise have hampered the ability of fishing authorities to monitor catch levels. This begins with a clear understanding of the fisheries themselves, the type of fish that spawn and feed in such areas, population levels and species biology.

Australia has developed a high level of expertise in the science needed to assess fisheries, to monitor catches and to ensure long-term sustainability.

To ensure fish and marine environments survive, ACIAR is partnering with developing countries in the region to identify solutions to protect the livelihoods of poor fishing communities. If overfishing is allowed, stocks of many high-value species may be depleted to the point of no return.

Collaborative initiatives to share our scientific expertise with Indonesia, the Philippines, East Timor, Papua New Guinea and Pacific island countries are underway, building cooperative links for the management of fisheries in the region.

Indonesia and the Philippines have agreed to cooperate in tackling the problems created by illegal, unreported and unregulated fishing in the Sulawesi Sea. If left unaddressed, it is likely that fish populations will collapse, and the Sulawesi Sea will be fished out.

Policy researchers supported by ACIAR are assisting both countries to formulate a joint management plan, ensuring a more sustainable approach to management and one that may help recoup much of the estimated $US5 billion a year in losses.

Australia is also developing strong bilateral partnerships, including with Indonesia, to manage shared fishing grounds.

FISH FOR FEED, OR FISH FOR FOOD?

Surface tension: trash fish or cash fish.

For more than a decade, Indonesian and Australian experts have been working together to improve understanding of stocks and the impact of fishing on high-value species in the Arafura and Timor Seas. These waters are breeding and feeding grounds of many fish.

The needs and interests of small-scale fishers as well as larger fleet owners from Australia and Indonesia are being listened to, ensuring that mutual interests are accommodated in future management plans.

These research partnerships are also examining ways to improve fish farming to alleviate the pressures global demand is creating.

Successful farming of marine finfish and other high-value species such as mud crabs presents many challenges – finding the right feeds, managing disease outbreaks and ensuring local environments do not suffer.

Australia, Indonesia and the Philippines have worked together to develop production systems for raising juveniles of several high-value grouper species, as well as mud crabs. The work is already helping poor communities in Bali, where over 600 backyard hatcheries are producing healthy fish for sale, locally and increasingly to the lucrative live-fish markets of Asia.

Re-stocking of depleted coral species is helping indigenous rural communities in northern Australia, eastern Indonesia and the Pacific, who have traditionally lived off coral reefs.

Aboriginal communities in the Kimberley region have established hatcheries to raise young topshell (a species of trochus), the conical shell which is valued by the fashion trade.

Local communities have taken the initiative and are working with fisheries authorities to reseed nearby reefs, in an effort to restore the local industry.

For villages and communities throughout the Asia-Pacific region, opportunities to sustainably exploit local fishing grounds are likely to be preserved, ensuring they, Australia and the world's oceans all win.

GEOFF ALLAN:

Aquaculture is the fastest growing food producing sector in the world. Fish is a main protein source for many in developing countries, representing up to 25 percent of protein intake.

Fish farming, or aquaculture, is increasingly meeting this rising demand, but at the heart of aquaculture production is a fundamental tension – fish for feed versus fish for food.

Where in the wild, fish feed on other marine life for survival, in aquaculture it stands to reason the best way to grow healthy fish remains to feed them other fish.

This has been the dominant viewpoint in aquaculture since the industry first began.

So fish are caught to produce fishmeal and fish oil as feeds for species suitable to aquaculture. To a lesser extent, fishmeal and fish oil are also used for feeding terrestrial animals and to a small degree in human diets.

But these fish must come from somewhere – the world's oceans still being the main source. The dilemma is that production (in tonnes) of fishmeal and fish oil consumed by aquaculture requires roughly three times more raw fish (in tonnes) than the final product. This ratio of three to one for raw fish caught versus fishmeal and fish oil consumed is of great concern.

Yet overall production of fishmeal and fish oil remains relatively static. Increases in their use in aquaculture are being offset by decreases in other sectors.

As a result international research has focused, over the past 15 years, on identifying alternative protein and lipid food sources suitable for aquaculture, shifting the once dominant view of fish to feed fish and addressing this tension between fish for feeds and food.

Fishmeal has been completely replaced in the diets of many aquaculture species, or used at significantly reduced levels.

So too has fish oil consumption been reduced, now included at much lower proportions in feed diets.

Whole fish have also been increasingly used. Known as trash fish – species that when caught were previously discarded – they are fed mainly to species of marine fish and crustaceans in Asia and increasingly elsewhere.

Research is needed to assess the impacts of fishing for trash fish, which are rising in value, in recognition of their increasing value to aquaculture. But as catches rise, the impacts on coastal waterways and in-shore fisheries are likely to rise.

Another research priority is continued evaluation of the potential and current place of formulated feeds, as a replacement for fishmeal. These feeds are based on utilising protein found in grain cereals, oilseeds and legumes.

The main barriers to using such feeds are developing cost effective techniques to concentrate protein and then evaluating these in aquaculture settings with a variety of species.

Successful research has been a significant factor in rising global aquaculture production. The challenge now is to build on this research to limit pressures on wild fisheries before the demand for fish for feed causes long-term damage to the sustainability of fish for food.

AUSTRALIAN YOUTH AMBASSADORS FOR DEVELOPMENT

Many young people leave Australia each year to see the world, but one group does so to make a difference in a developing country.

Australian Youth Ambassadors for Development (AYAD) undertake short-term assignments to help with international development activities in Asia-Pacific countries.

The AYAD scheme places skilled young Australians aged 18-30 in a development opportunity. Placements are sponsored from either the private sector, an NGO or the government sector through an assignment from that organisation. ACIAR is one such sponsor organisation and has provided more than 20 assignments that have exposed young Australian scientists to research institutions and activities in partner countries.

The reports on this page and page 28 are just a few examples of ACIAR youth ambassador projects that currently cover Indonesia, Laos, Cambodia, Vietnam, Tonga, the Philippines and China.

WATERWATCH IN THE PHILIPPINES

In Australia, water quality monitoring through community-based Waterwatch programs has become an integral part of the Australian Landcare movement. In the Philippines, a similar need and interest developed and an opportunity to support this with Australian expertise was facilitated in 2002, when the ACIAR Philippines-Australia Landcare Project placed an Australian Waterwatch volunteer in the Philippines at Claveria. **LOUISE HATELEY** was that volunteer. She writes:

I had just completed a Diploma of Conservation Ecology in 1999 when I heard about a Waterwatch position in my local catchment at Ginninderra, near Canberra, Australia. I spent a year as the local coordinator working alongside the Ginninderra Landcare coordinator, running workshops with community groups to raise awareness about stormwater runoff, and training groups to monitor their local section of the creek.

After this, I helped Waterwatch in the Australian Capital Territory (ACT), before attending James Cook University in north Queensland to undertake a Bachelor of Environmental Science. I heard about the volunteer position in the Philippines in March 2002 and had to go.

At Claveria I familiarised myself with the International Center for Research into Agroforestry (ICRAF) Landcare program, and Filipino culture.

The next step was to train facilitators and write material for some of the communities in the area. That took up most of my time, as well as taking school groups and Landcare groups to their local creek for some enjoyable, hands-on experiences with Waterwatch.

They were the most enthusiastic and eager group I have ever met. Implementing the Waterwatch program took longer than I had planned, but I had not appreciated that things would take more time to happen, given the challenges of cross-cultural communication. When I left Claveria for Bohol six months later because of safety concerns. I felt that I had only just started to get things off the ground and was sad to leave.

In Bohol I was able to get involved in other water quality projects in the area and produced a Waterwatch manual, which is now helping Waterwatch groups in Claveria, Bohol and other areas.

The highlight was the Waterwatch workshop that I organised with ICRAF staff and facilitators, local government officials and NGO representatives. We spent three days reviewing the manual and undertaking hands-on activities. Seeing it all come together, being able to spend time with people from different parts of the country, and to know that I was leaving a useful resource behind, was very rewarding.

Louise's work in Bohol will now be reinforced by the assignment of Carl Mitchell to an AYAD project working with the World Agroforestry Centre and the Bohol Watershed program. Carl will spend 12 months working with the local community in Bohol to develop Community Monitoring and Waterway management.

ACIAR is working with the World Agroforestry Centre and the Queensland Department of Primary Industries and Fisheries to draw up Carl's assignment, with extra support from Queensland Natural Resources and Mines and the University of Western Sydney.

Useful resource: Louise Hateley at a Waterwatch workshop.
Photo: Philippines Waterwatch

LANDCARE IN THE PHILIPPINES

Soil erosion is a major problem in Mindanao, and elsewhere, where steep sloping hillsides are farmed. Initial attempts to resolve this problem, headed by ICRAF, focused on the use of hedgerows to reinforce sloping fields.

With ACIAR playing the role of facilitator to extend this work, the concept of caring for the land, arising from the ICRAF initiative has been furthered with the Australian Landcare model.

The project has ensured that positive environmental interactions have been sustained, by linking farmer groups with training and support networks. This now involves active Landcare groups throughout Mindanao, comprising more than 4500 members.

About 500 backyard nurseries to supply plants have been established, allowing the original hedgerow concept and other practices to reduce soil erosion. Farmer research committees have been formed and a central Landcare facility, including an office, demonstration nursery and farm and information centre, has been established at Lantapan.

Photo: AusAID

CUTTING POSTHARVEST LOSSES IN MELONS IN CHINA

Kim-Yen Phan-Thien is working in China as an Australian Youth Ambassador assigned to ACIAR's project that is improving postharvest handling and disease control of melons.

Melons are a potentially valuable source of income for many smallholder farmers. Significant postharvest losses, however, are undermining this potential. Kim's role focuses on designing, implementing and analysing experiments that help characterise natural disease resistance.

Her work began in Lanzhou, Gansu Province, in central China. Since then Kim has moved to Urumqi in Xinjiang in the far west. ACIAR's program in China is increasingly emphasising research that supports agriculture in these poorer regions.

Kim says her AYAD placement has had tangible benefits for both Australian and Chinese researchers. The social and cultural contexts for planning and carrying out experiments, and the approaches for resolving problems, are very different in China and Australia.

She says limited finance and access to resources in the poorer western regions of China have a much larger influence on experimental practice than many Australian researchers would imagine.

These differences can be difficult to bridge via long-distance communication, language barriers notwithstanding.

She feels the facilitation of better understanding between Chinese and Australian researchers is where her role as an AYAD has been most valuable.

Photo: AusAID

LEARNING TO SING TO A NEW TUNE

ADAM BARCLAY is an Australian Youth Ambassador for Development assigned to the International Rice Research Institute (IRRI), in Los Banos, Philippines. He writes:

When I accepted the offer to become a youth ambassador at IRRI I didn't expect to sing "Old Macdonald Had a Farm" to a group of rice farmers in Bangladesh. But that's the beauty of setting off to work as a volunteer – life is not predictable.

I travelled to Bangladesh as an IRRI Communications Officer – a placement facilitated by the Crawford Fund – to increase public awareness of the institute and the importance of rice research, a timely issue in 2004, the International Year of Rice.

There, I gathered material for a story on an IRRI-led project that saw thousands of rice farmers perform experiments in their own fields which proved that spraying insecticides was a waste of time and money (see the October-December edition of IRRI's Rice Today magazine; or www.irri.org/publications/today/index.asp).

My two American travelling companions and I sang (complete with quack-quacks and moo-moos) for the farmers after they requested a "farm song".

Before coming to the Philippines, I – like many Australians – failed to appreciate the global importance of rice. It is the staple that feeds almost half the planet, and is the single most important source of employment and income for rural people worldwide. Hundreds of millions, including the poorest of the poor, rely on it for sustenance every day.

POSTHARVEST TREATMENT OF MELONS

ACIAR funded an earlier project, 'postharvest handling and disease control in melons', which affirmed the importance of the melon industry in Western China and the scope for improvements in disease control and supply chain technologies.

The latest project aims to improve postharvest disease control and market quality, and improve returns to growers in China and Australia.

Project activities include the strategic application of preharvest treatments to boost natural defence mechanisms in melons, and postharvest treatments to control disease and maintain quality.

Researchers will also develop and test interventions that improve supply-chain management, analyse the economic benefits associated with using modern postharvest technologies and transport systems, and identify practical options to improve farmer profitability.

IRRI AND AUSTRALIAN AID

Adam Barclay is working at IRRI, one of the International Agricultural Research Centres that receive funding for core activities and projects from ACIAR, as administrator of the Australian Government's contribution to these centres.

IRRI is a centre of particular strategic importance to the Australian aid program. It is the centre dealing with rice (the major staple grain in the Asia-Pacific region). IRRI has helped facilitate the global exchange of more than 40,000 plant breeding lines and varieties since 1975.

National breeding programs have used more than 3000 breeding lines and cultivars to improve local varieties in 64 countries, with an estimated value to the world economy of $US1477.5 million.

VAVILOV-FRANKEL FELLOWSHIP AWARDED TO ACIAR SCIENTIST

Tamar Jinjikhadze, a scientist from Georgia involved in an ACIAR project collecting germplasm in the Central Asian region, has been awarded a prestigious Vavilov-Frankel Fellowship. The fellowships were established in 1989 by the International Plant Genetic Resources Institute (IPGRI), to commemorate the contributions made to plant science by Nikolai Ivanovich Vavilov, of Russia, and Australia's Sir Otto Frankel, a pioneering chief of CSIRO Plant Industry.

Ms Jinjikhadze's fellowship is supported by the Australian Grains Research and Development Corporation and Pioneer Hi-Bred International Inc.

The fellowship will allow Ms Jinjikhadze to study *Triticum timopheevii*, a species of wheat found in Georgia. An important aspect of the fellowship is the opportunity to expand research skills and capability through study in Australia at Sydney University.

Ms Jinjikhadze will study the molecular basis of resistance to rust diseases in *T. timopheevii*.

Low wheat yields in Georgia are partly due to the prevalence of rust diseases. Ms Jinjikhadze will spend her fellowship assessing *T. timopheevii* samples for resistance to the known races of rust disease.

This research is a microcosm of that being undertaken by the ACIAR project to collect germplasm in the Central Asian Republics and the Caucasus.

Many varieties of widely grown cereal crops originated in these areas, and ACIAR has been working with ICARDA to collect, conserve and preserve as much of this storehouse of wild cereals as possible.

Resistance to diseases such as rust, as well as traits that allow crops to adapt to a wide variety of environments and stresses may be lost if this germplasm is not preserved.

Through the ACIAR-ICARDA project, research capacity in germplasm conservation has been developed and will be continued through a follow-up project.

PEARLS OF PROMISE

The results of an ACIAR-supported research project to develop the black pearl industry in the Solomon Islands were showcased at a charity auction of Solomon Island pearls in Sydney on 30 June.

The auction raised about $25,000 for the Gizo hospital in Western Province, the area of the Solomon Islands where the pearls were grown.

Pearl production has been developed in a pilot pearl farm, linked to an ACIAR project through the WorldFish Center.

Sixty of the 90 lots on offer at the auction sold. The remainder are now being offered through jewellers in Sydney as a further way to expose the project's importance to the Solomon Islands.

ACIAR, with the WorldFish Center and the Government of the Solomon Islands, has been collaborating in a project to refine the industry's development through improved techniques to grow and culture black lip pearls.

The black pearl oyster (*Pinctada margaritifera*) flourishes in atoll lagoons and is an important export earner for French Polynesia and the Cook Islands.

An ACIAR-WorldFish project involving Tonga and Kiribati is also linked to a pilot pearl farm activity with the WorldFish Center in the Solomon Islands.

NEW PROJECTS

ADP/2002/012 – Technical change in Thai and Indonesian agriculture: measurement, socio-economic impact and policy implications

ASEM/2003/012 – Improving the marketing system for maize and soybeans in Cambodia

ASEM/2003/011 – Herbicide use strategies and weed management options in Filipino and Australian cropping

AS2/2002/079 – Utilisation of local ingredients in commercial feeds for pigs

CIM/2004/004 – Plant genetic resource conservation, documentation and utilisation in central Asia and the Caucasus

CIM/2004/003 – Plant health management for faba bean, chickpea and lentils

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

FIS/2003/037 – Artisanal shark and ray fisheries in Eastern Indonesia and their relationships with Australian resources

FIS/2002/068 – Improving feeds and feeding for small scale aquaculture in Vietnam and Cambodia

FIS/2002/001 – Developing aquaculture in degraded inland areas in India and Australia

FST/2003/002 – Development and evaluation of sterile triploids and polyploid breeding methodologies for commercial species of acacia in Vietnam, South Africa and Australia

FST/2002/097 – Identification of optimum genetic resources for establishment of local species of sandalwood for plantations and agroforests in Vanuatu and Cape York Peninsula (Australia)

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

LWR/2003/006 – Enhancing agricultural production in the Philippines by sustainable use of shallow groundwater ▶

- **LWR/2002/085** – Utilising basic soil data for the sustainable management of upland soils in Vietnam and Australia
- **LWR/2000/013** – Sustainable agriculture in saline environments through serial biological concentration
- **PHT/1999/081** – Reducing spoilage and contamination risks of fresh vegetables in China and Australia
- **SMCN/2004/002** – Wheat and maize productivity improvement in Afghanistan
- **SMCN/2002/073** – Efficient nutrient use in rice production in Vietnam achieved using inoculant biofertilisers

PROJECT VARIATIONS

ACIAR projects may be varied to extend the time to completion, to increase the budget available or both. Project variations and extensions are undertaken following a review process of the project, that involves both internal and external review phases.

- **AS1/2000/009** – Development of diagnostic and control methodologies for animal trypanosomiasis (Surra) in Papua New Guinea, Indonesia, the Philippines and Australia
- **AS1/1998/054** – Poverty alleviation and food security through improving the sweet potato-pig production systems in Indonesia and Vietnam
- **CIM/1996/140** – Biological threats to Saccharum germplasm and sugar production in Papua New Guinea, Indonesia and Australia
- **CP/2000/090** – Liriomyza huidobrensis leaf miner: developing effective pest management strategies for Indonesia and Australia
- **FIS/2001/034** – Inland pond aquaculture in Papua New Guinea – assessment of the industry and evaluation of smallholder research and development needs
- **FST/1998/118** – Planning methods for sustainable management of timber stocks in Papua New Guinea's forests
- **FST/1998/115** – Domestication of Papua New Guinea's indigenous forest species
- **FST/1998/113** – Development of a sustainable, community-based essential oil industry in the Western Province of Papua New Guinea using the region's woody-plant species.

NEW PUBLICATIONS

PROCEEDINGS

Water in Agriculture
The availability of water and water quality are major concerns for everyone. Agriculture is the largest consumer of water. As the world's population increases, how do we increase food production with limited water and land resources? These proceedings cover the papers presented at the CARDI International Conference 'Research on Water in Agricultural Production in Asia for the 21st Century', held in Phnom Penh, Cambodia in November 2003. **Vang Seng, Eric Craswell, Shu Fukai and Ken Fischer** (eds) 2004. ACIAR Proceedings 116, 240pp. Price $25 (plus postage and handling).

MONOGRAPHS

Anthracnose resistant *Stylosanthes* for agricultural systems
A summary of new knowledge about *Stylosanthes* research and development. Both published and unpublished information on anthracnose disease and the development of new germplasm with anthracnose resistance and high yield potential for existing and new production systems is included. **S. Chakraborty** (ed.) 2004. ACIAR Monograph 111, 266pp. Price: $45 (plus postage and handling).

Advances in grouper aquaculture
Aquaculture of high-value finfish species, such as groupers, is an industry of increasing importance throughout the Asia-Pacific. This book looks at larval rearing to improve growth and survival of groupers during the hatchery phase; diet development to produce feeds with low environmental impact; and support for the NACA Grouper Aquaculture Research and Development Network. **M. Rimmer, S. McBryde and K. Williams** (eds) 2004. ACIAR Monograph 110, 138pp. Price $22 (plus postage and handling).

Community-based resource planning: studies from Zimbabwe and northern Australia
This monograph describes research activities and outcomes from the ACIAR funded project 'Enhanced Resource-Use Planning for Tropical Woodland Agroecosystems' based in Zimbabwe and northern Australia. Its findings provide an improved framework for resource use planning in tropical woodlands. **R.N. Thwaites, J.L. Carter and P.L. Norman** (eds) 2004. ACIAR Monograph 109, 126pp. Price $28 (plus postage and handling).

TECHNICAL REPORTS

Feeds and Feeding for Inland Aquaculture in Mekong Region Countries
Aquaculture of freshwater species in the Mekong regions of Cambodia, Vietnam, Lao PDR and Thailand is an important source of protein and income for small-scale land owners. But the cost of feed is constraining development of aquaculture. This report describes the current situation with feeds and feeding for inland aquaculture in these countries and identifies the research and training needed to benefit small-scale aquaculture producers. **Peter Edwards and Geoff Allan** (eds) 2004. ACIAR Technical Report 56, 136pp. Price $17 (plus postage and handling).

Trials of Cold-tolerant Eucalypt Species in Cooler Regions of South Central China
Eucalypts are of considerable economic, social and environmental importance in southern China. ACIAR has supported collaborating forestry research between China and Australia since 1985. This report draws together the results of many trials undertaken over the past 20 years into eucalypts suited to mean annual temperatures of 15 to 20C, with absolute minima down to -8C. **R.J. Arnold, B. Clarke and J. Luo** (eds) 2004. ACIAR Technical Report 57, 106pp. Price $17 (plus postage and handling).

Evaluation of International Provenance Trials of *Casuarina equisetifolia*
The results published in this report reveal a considerable amount of genetic variation between provenances of *Casuarina equisetifolia* and provide important information for people interested in agroforestry and fuelwood production in the tropics and subtropics. **K. Pinyopusarerk, A. Kalinganire, E.R. Williams and K.M. Aken** (eds) 2004. ACIAR Technical Report 58, 106pp. Price $17 (plus postage and handling).

WORKING PAPERS

Forages for red soils area of China J.M. Scott, D.A. MacLeod, Minggang Xu and A.J. Casanova (eds) 2004. ACIAR Working Paper 55, 200pp. All papers available at *www.aciar.gov.au*

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NEW APPOINTMENTS

NEW CHAIR OF THE ACIAR BOARD OF MANAGEMENT

Photo: ACIAR

Dr Meryl Williams has been appointed chair of the ACIAR Board of Management, and President of the Policy Advisory Council. The appointment was announced by the Minister for Foreign Affairs, Alexander Downer, on 11 August 2004.

Dr Williams takes over from Professor Beth Woods OAM. Professor Woods has taken a new position as executive director R&D Strategy in the Queensland Department of Primary Industries and Fisheries.

Dr Williams' professional interests are in research for development, research management and the role of fish and other living aquatic resources in people's lives.

Dr Williams is inaugural executive officer of the Future Harvest Alliance Office, formed in 2004 by the 15 international agricultural research centres of the Consultative Group on International Agricultural Research (CGIAR). Prior to this, she was director-general of WorldFish Center from 1994-2004.

Dr Williams was previously director of the Australian Institute of Marine Science (AIMS) and was a member of the AIMS Council from 1989 until June 1997. She was executive director of the former Bureau of Rural Resources in the Department of Primary Industries and Energy, Canberra, and worked in fisheries research at the South Pacific Commission and in the Queensland Government. She was a member of the first board of the Australian Fisheries Management Authority and, from 1989 to 1993, was a member of the Council of the Australian Maritime College.

Dr Williams is also the chair of the FAO Advisory Committee on Fisheries Research, and a member of the scientific steering committee of the Census of Marine Life, the High Seas Marine Protected Areas Working Group and of the scientific committee of DIVERSITAS. She has published extensively in the scientific and development literature on tropical fisheries and aquaculture and has a PhD in Zoology and a Masters Degree in Literary Studies (mathematical statistics).

Dr Russell Haines is ACIAR's new Forestry Research Program Manager. The Forestry Program focuses on the establishment, management and sustainable utilisation of forests.

Dr Haines joins ACIAR from the (Australian) Rural Industries Research and Development Corporation, where he was an acting general manager.

Until late 2002, he was chief executive of the Queensland Forestry Research Institute (QFRI). He has a background as a forestry researcher and research manager in breeding, silviculture, water and nutrition, forest protection and product processing.

He also has considerable experience in strategic planning, financial management and business processes.

Ms Amber Davidson is ACIAR's new country manager in Indonesia. Ms Davidson is an AusAID officer who is on leave-without-pay, working for the Secretariat of the Pacific Community (SPC) in Suva, Fiji, as planning adviser in the Land Resources Division.

At AusAID Ms Davidson has worked in a variety of program areas, including program evaluation, budget and planning and on AusAID programs/projects in PNG and the Solomon Islands. Ms Davidson also managed the secretariat functions of the 2002 Aid Review.

Prior to joining AusAID in 1997, she was research director with the University of Sydney, where she led a social and economic research team of 12 researchers. Her area of expertise is in urban and regional planning. Ms Davidson has a Masters (Hons) in Urban and Regional Planning and a Bachelor of Science (Hons) in Environmental Science and Ecology.

Ms Davidson will join ACIAR in October 2004.

Photo: ACIAR

Christian Roth is ACIAR's research program manager for Soil Management and Crop Nutrition. The program focuses on land and cropping systems and soil management at the field scale. Dr Roth has a PhD in Soil Physics from the University of Goettingen, Germany, where he also obtained a degree as Diplom-Agraringenieur (agricultural sciences).

He worked in southern Brazil as part of the German Agency of Technical Assistance (GTZ) project on erosion control in mixed cropping systems, using no-tillage techniques. Dr Roth was a lecturer and researcher in soil physics at the Department of Soil Science, Institute of Ecology, at the Technical University of Berlin, specialising in measuring soil hydraulic properties and rainfall simulation studies.

He joined the CSIRO's Multidisciplinary Coastal Zone Program based in Townsville in 1996 in the position of principal research scientist, and was later appointed research group leader of Tropical Land and Water Management for Sustainable Land Use at CSIRO Land and Water. From 1998, he was also acting officer-in-charge of CSIRO's Davies Laboratory.

ACIAR'S VISION

ACIAR looks to a world where poverty has been reduced and the livelihoods of many improved through more productive and sustainable agriculture emerging from collaborative international research.

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

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