



# The gift of food security

By drawing on genetic diversity to improve crop varieties in developing nations that have experienced civil unrest or war, Australians and Australian aid, and ACIAR in particular, help communities along the road to social and economic recovery

BY GIO BRAIDOTTI

Originally established to alleviate world hunger, the international agricultural research centres responsible for the Green Revolution are now participating in a new kind of aid action. With their seed collections that facilitate the development of better-performing crop varieties, the 15 centres of the Consultative Group of International Agricultural Research (CGIAR) and their sponsors, including Australia, are helping nations rebuild run-down or destroyed farming infrastructure following manmade and natural calamities, such as the 2004 tsunami.

Through a series of AusAID–ACIAR joint projects, Australia is heavily involved in these international efforts, which currently include restoring food productivity in Afghanistan, Iraq and East Timor. Unlike humanitarian emergency relief, which provides critical support in a disaster's immediate aftermath, agricultural aid aims to establish a deeper and more enduring food security capability.

The paradigmatic example of this form of aid is Cambodia following the Khmer Rouge atrocities in the 1970s. Rice production in Cambodia, one of South-East Asia's leading rice exporters in the late 1960s, fell by 84% during the purges that sought to overturn modern agriculture. In the aftermath, not only were the

farmers, scientists and agronomists missing or displaced, so were the rice varieties, and their seed stocks, that were needed to keep the population alive.

In emergencies such as this, donor countries willingly provide emergency food supplies, including seed, but this provides only short-term relief. What is missing is the long-term selective breeding that creates crops specifically adapted to any one country's agro-climatic conditions, which include idiosyncrasies in soil, pest, disease and rainfall profiles, in addition to differences in farming practices. Without this in-built adaptation to local conditions, introduced crop varieties tend to perform poorly.

What proved critical in Cambodia's recovery and avoidance of widespread famine was the fact that a CGIAR centre—the International Rice Research Institute (IRRI)—had undertaken a seed-collection mission in Cambodia prior to the crisis that befell the country. Safely stored and catalogued in IRRI's genebank in the Philippines was Cambodia's own germplasm—the rice varieties familiar to farmers.

In the 1980s Australia made special funds available to use this collection to rebuild Cambodia's rice farming, beginning with basic crop production and then moving on to the country's technical and research infrastructure.

Led by Australia's Dr Harry Nesbitt, the



Dr Harry Nesbitt training a young plant breeder, Ms Thun Vathany, at the Cambodian Agricultural Research and Development Institute in 2001.



Dr Brian Palmer, the Seeds of Life's first on-the-ground project leader, made his scientific expertise available to help East Timor improve the performance of its staple crop varieties.

PHOTOS: BRAD COLLIS

Cambodian–IRRI–Australia Project (CIAP) was launched in 1988 and in just seven years achieved a rice surplus. Using the varieties dispatched by IRRI, rice production during the CIAP years increased 70%, with the underlying research infrastructure providing the means to develop a more diversified agricultural economy. For his 13 years on the ground in Cambodia, Dr Nesbitt was awarded a Member of the Order of Australia in 2003.

The impacts of projects such as CIAP are far-reaching for donor and partner countries alike. By promoting food security where people's lives previously rested precariously on indifferent soils, practices and seasons, Australia's agricultural aid system helps to develop stability, security and goodwill.

Not only does ACIAR administer Australia's contribution to the CGIAR centres, ACIAR also participates in collaborative projects and mounts its own missions to support and commission research to develop and deliver improved crop varieties.

The need and the work is ongoing, and ACIAR is providing crucial agricultural support through missions in East Timor and Iraq, and a CGIAR-led program in Afghanistan.

## EAST TIMOR

Like the earlier CIAP project in Cambodia, the Seeds of Life (SoL) project in East Timor involves a long-term program to rebuild agriculture in a country facing a precarious and worsening food security situation. A Portuguese colony for 400 years and an Indonesian province from 1975, East Timor faced a looming food crisis when it achieved independence in 1999 after a United Nations-sponsored referendum.

Originally commissioned by ACIAR, SoL was launched in 2000 while East Timor was still in transition from UN administration. With the involvement of Dr Colin Piggin and then Dr Nesbitt, SoL set out to strengthen East Timor's farming system by developing higher-yielding, better adapted varieties for each of the nation's major food crops.

To achieve that goal, SoL called on five CGIAR centres whose genetic resources are now underwriting the development of improved varieties of the most important staple crops:

- irrigated rice—IRRI
- sweet potato—the International Potato Center in Peru
- maize—the International Maize and Wheat

- Improvement Center (CIMMYT) in Mexico
- cassava—the International Center for Tropical Agriculture in Colombia
- peanuts—the International Crops Research Institute for the Semi-Arid Tropics in India.

With most of East Timor's one million people involved in farming—and cropping providing most of the staple food—the program stands to make a real difference to the 80% of the East Timorese population estimated by the World Food Program to endure food shortages each year.

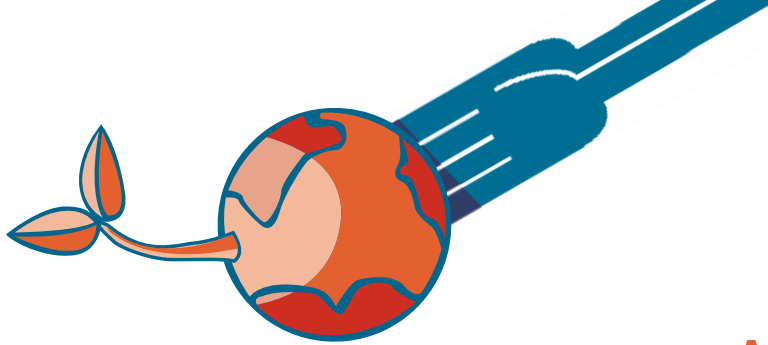
"Since independence, food security in East Timor has been fragile," Dr Nesbitt says. "The nation has a relatively small cropping area—just 336,000 hectares for 140,000 rural households—and farmers are relying on low-yielding varieties, poorly suited to local growing environments."

To unravel the compounding difficulties, there have been two phases to the project. In the first, scientists accessed suitable germplasm, rebuilt the expertise and infrastructure needed to develop new varieties, and began a multi-site testing program to evaluate and select the best adapted lines. In the second phase, which is underway, on-farm trials are testing and promoting the new varieties, a research station and seed storages have been built, and bulking up of seed for distribution is ongoing. A new generation of extension officers and technical staff to liaise with farmers is also being brought into the system—a feat aided by Australia's provision of motorbikes.

From the outset, the program anticipated that a new Ministry of Agriculture would become the principal collaborator. This took place in 2002 with the formation of the Ministry of Agriculture and Fisheries (MAF). Throughout the transition to self-government, the program has been staffed on the ground by Australian advisers, starting with Dr Brian Palmer, SoL's first on-the-ground project leader. It subsequently involved Brian Monaghan—responsible for making the Betano agricultural research station operational—and Rob Williams, who has close ties with the National University of East Timor in Dili, as well as being the current Australian project leader.

With the launch of the AusAID–ACIAR-cofunded second phase in 2005, about 700 East Timorese farmers from different agro-climatic zones have also joined the SoL team, and MAF is increasingly funding positions within the program.

"The on-farm component helps us check whether the new varieties perform well when



cultivated using subsistence farming practices,” Mr Williams says. “Because these are low-input systems—in terms of fertilisers, herbicides and pesticides—the trials are answering a really important question, ‘How much yield gain is possible based solely on improved varieties and in the absence of other inputs?’”

With three years’ data now available, the yield increases achieved on the back of genetic gain have exceeded Mr Williams’s expectations. “For maize, harvests are up 40% at both research stations and on farms that did not have access to extra inputs,” he says. “Two yellow maize varieties have been released and a sweet-tasting white maize that is no more difficult to pound is on its way.”

Similarly, rice yields are 20% higher using an IRRI line highly valued for its taste. Uptake has been widespread, Mr Williams says, with some regions managing to bring two, and even three, rice crops to harvest in one year. “The new rice varieties now dominate some areas. And they taste fantastic. You see, this is not just about yields. It’s food—taste is important too.”

New sweet potato plantings are proving

a success, producing tubers that are up to 10 times larger than the local varieties. Farmers participating in field trials took cuttings to grow on their own land, resulting in new varieties finding their way to market even before trials were completed.

Groundnuts (peanuts) are the cash crop in the system and a large-seeded variety from India is yielding 20–30% more, while offering the desirable qualities of sweet taste and oily texture. Only a cassava release is still outstanding, but four varieties are under trial and are being evaluated for taste, nutritive value and acceptability.

So far SoL has released seven crop varieties, with more in the pipeline—a remarkable success rate by any standard and a stark contrast to the R&D deficit that previously characterised farming in East Timor.

“Since the 1960s crop yields have remained stagnant at a time when comparable countries doubled their harvests,” Mr Williams says. “East Timor missed out on those productivity gains. That’s what SoL is changing—we are bringing the Green Revolution to East Timor.”

## AFGHANISTAN

Given his position managing ACIAR’s Crop Improvement Program, Dr Paul Fox routinely receives calls from journalists covering Afghanistan.

Despite ongoing efforts to provide Afghan farmers with the means to reverse the nation’s debilitating grain yield deficit, Dr Fox is routinely bemused when journalists talk about poppy as the principal crop.

“Wheat is far and away Afghanistan’s most important crop,” he says. “It accounts for 70% of the nation’s crop area, it is the number-one staple crop, and it is crucial in terms of people’s food security. Yet according to CIMMYT, crop yields since 1978 have declined about 50% and currently fall short of demand by 1.5 million tonnes a year. That makes wheat the main cropping story in Afghanistan.”

In the early 2000s, CGIAR scientists and the Afghan Ministry of Agriculture, Irrigation and Livestock (MAIL) arrived at similar conclusions regarding the extent of the damaging deficit. As in Cambodia in the 1970s, farming infrastructure in Afghanistan had

PHOTO: PHOTOLIBRARY.COM

With wheat yields in Afghanistan falling short of demand by 1.5 million tonnes a year, ACIAR is providing support to help rebuild farming infrastructure and provide better performing wheat and maize varieties.



collapsed. Ominously for future recovery, the damage extended to the nation's agricultural biodiversity.

Although food aid protects against malnutrition in the short term, the country's need to regain food security is acute. Towards that end ACIAR, with funding assistance from AusAID, is supporting CIMMYT-led efforts to improve Afghanistan's wheat and maize varieties, while concurrently strengthening the nation's underlying farming capacity, agricultural infrastructure and scientific facilities.

The need for precisely this capacity building was emphasised recently when the Afghan government and the international donor community met in Paris to decide the nature of future assistance to Afghanistan. Some \$15 billion has been spent on reconstruction in Afghanistan since 2001, including about \$500 million in the agricultural sector. Yet, according to figures presented at the Paris meeting, the percentage of people living below the minimum dietary level has increased from 30% to 35% in the past year. One statistic highlights the staggering nature of Afghanistan's need to rebuild capacity: foreign aid accounts for 90% of all public expenditure.

With 85% of Afghani people engaged in agriculture, rebuilding national capacity essentially means rebuilding agriculture. An Agricultural Master Plan has been developed that places strong emphasis on cropping and capacity building. In line with these goals, ACIAR-supported projects focus action in four areas:

- screening seed collections for resilient and high-yielding new varieties of wheat and maize
- sourcing hundreds of tonnes of seeds for thousand of farmers
- rebuilding the agricultural infrastructure needed to test, bulk and distribute seed
- training Afghani scientists, technicians and extension workers to carry on the work.

An additional component is sponsoring the inclusion of farmers in testing the performance and acceptability of new varieties using traditional farming practices. Involving the farmers in the evaluation process means they end up ideally situated to form networks, which can bulk up and distribute seed and knowledge.

ACIAR's collaborative approach is identifying wheat varieties for wider release. The first, launched in 2003, was identified in Parwan province, where farmers displayed keen interest

in the Solh-02 variety. It was found to yield 50% more than existing varieties and had superior disease-resistance traits. The project is helping ensure that farmer demand for seed is met.

The search for suitable genetic material extends far beyond these efforts. It includes CIMMYT and the International Center for Agricultural Research in the Dry Areas' (ICARDA) own seed collections, plus varieties from neighbouring countries such as Iran and Pakistan. Even further afield, Afghan landraces collected more than 25 years ago for use in Australian breeding efforts are finding their way back to Afghanistan and into the CIMMYT screening program.

Special consideration is given to ensuring varieties are genetically protected from fungal diseases, since Afghani farmers rely exclusively on in-built genetic resistance. The rust diseases in particular have scientists concerned. Stripe (or yellow) rust has rapid rates of evolution capable of breaking down the genetic resistance of new varieties, and a new stem rust biotype called Ug99 is making its way eastward from Africa and has already reached Iran. On both fronts, the expertise of Australian researchers has been recruited to protect Afghanistan's future wheat crops from these threats.

Arrangements are also in place with MAIL to identify Afghani scientists for training. Fifteen scientists have undertaken international courses in breeding and crop evaluation. MAIL staff also received training, including learning diagnostic survey skills of yield-limiting factors.

With efforts on the agricultural front gaining momentum, support from Australia continues to be provided. In May 2008, the Parliamentary Secretary for International Development Assistance, Bob McMullan, made a further \$1.5 million in funding available through ACIAR and AusAID, specifically for agriculture-based aid activity.

The support is welcome. CIMMYT's country coordinator in Afghanistan Dr Mahmood Osmanzai says there are still real challenges to close the grain-yield gap. "We have good varieties that will make good bread, but now we have to find ways that let resource-poor farmers get the most from them."

## IRAQ

The scene is typical of field days anywhere wheat is cultivated: farmers sitting under a blue sky, listening to a presentation on new wheat varieties. In the background, demonstration

wheat fields offer visual proof of the potential for higher yields. Yet this scene is playing out in Ninevah Governorate, in northern Iraq, and is made possible by an AusAID-ACIAR project implemented under the leadership of Australian agronomist Dr Colin Piggan, of ICARDA.

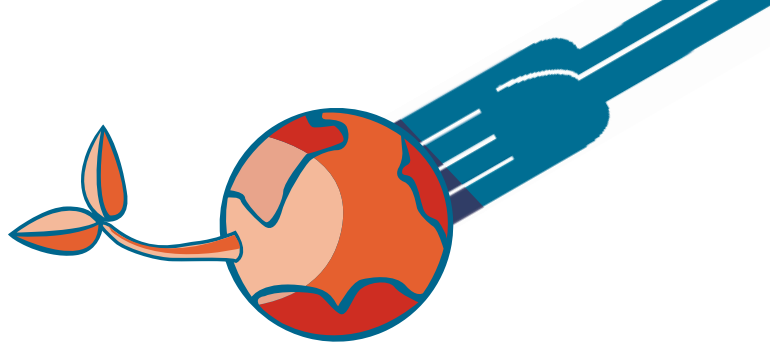
Although Iraq tends to inspire images of deserts, this holds true only in the south of the country. In the north, heading towards the mountains, annual rainfall increases to 400 millimetres in the flatter cropping zone and up to 1,000 mm in some mountainous regions. Wheat and barley are the dominant winter crops in these areas, sown across 3 million of Iraq's 9.5 million hectares of farmland. The northern cropping region provides 70% of the country's staple cereal crops.

The reliance on rain-fed cropping systems is mirrored in many parts of Australia and so too are rainfall and climate patterns. The similarity extends to the problems faced by farmers, such as drought and poor soil nutrition. However, in Iraq wheat yields average 0.73 tonne per hectare, less than half the tonnage achieved in Australia under similar conditions. This difference is mainly attributed to poor crop management and lack of modern crop varieties.

Overcoming these productivity problems is the aim of the ACIAR-ICARDA project that is targeting wheat and barley, as well as pulses and forage legumes. It combines the development of new varieties with research on conservation cropping techniques and a technology adoption program. In all, the project is seeing the oldest cereal-cropping region in the world adopt farming methods of one of the newest cropping countries, Australia.

Unlike most ACIAR projects, the expertise of international research partners is being accessed at arms length. Bypassing the more typical in-country interaction, the Australian partners meet their Iraqi counterparts at ICARDA's headquarters at Aleppo, Syria, to plan, discuss and review activities and achievements.

"Despite being unable to visit our Iraqi partners, we wanted them to have strong ownership of the project," Dr Piggan says. "On that score, they have done an extraordinary job with implementation and reporting; the Iraq Ministry of Agriculture demonstrated excellent leadership. Up and running are demonstrations on 12 major sites in farmers' fields and on research stations, plus the involvement of the agricultural department at the University of Mosul who are just excellent, flexible, lateral



In Iraq, efforts to rebuild agriculture is combining the development of new varieties with research on conservation cropping methods.

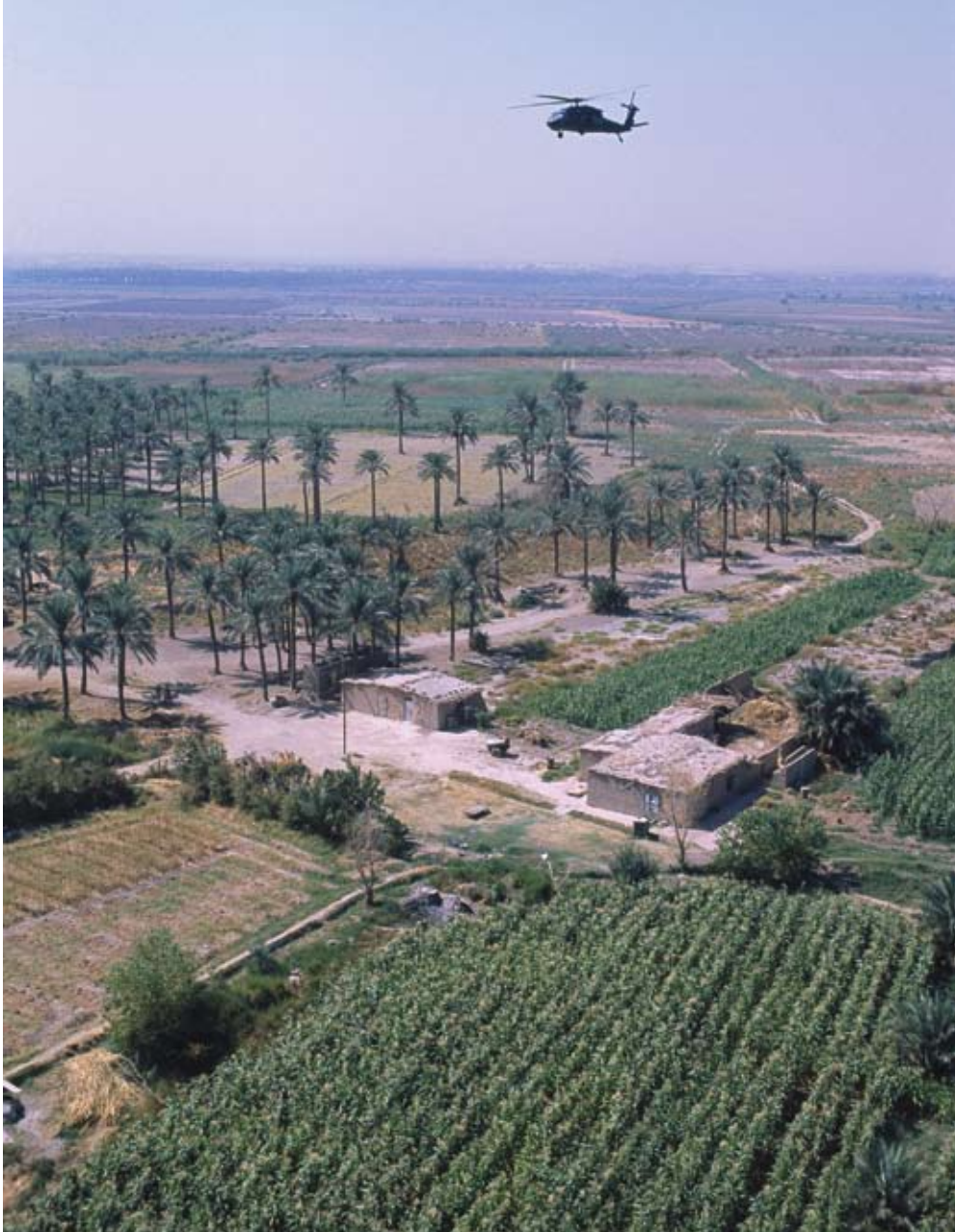


PHOTO: PHOTOLIBRARY.COM

thinkers—they really understand what this project is about.”

Project implementation within Iraq is led through the State Board of Agricultural Research (SBAR), which has a mandate to devise scientific solutions to the major problems limiting plant and animal production. Training of Iraqi crop scientists occurs at ICARDA's Syrian headquarters or in Australia, with plans underway to extend the training program within the next three-year phase of the project.

High-yielding varieties were selected for

planting from the 2005 to the 2008 winter cropping seasons, with farmers invited to participate in these trials. Newly established field nurseries are helping to boost seed for promising varieties, including six wheat and five barley lines. These inspired questions about farming practices that can make the most from the genetic gain.

“From the outset the project involved a lot of agronomists and had a twin focus that included improving farming techniques,” Dr Piggin says. “The focus is on conservation cropping, which

is made up of three components: zero-tilling of soil, retaining the stubble from the previous crop, and diversifying the rotation rather than sowing cereals in consecutive years.”

When the project first started there was no knowledge of conservation cropping and the Iraqis were sceptical that it would work. Traditionally, farmers cut stubble and plough fields before replanting. However, Dr Piggin recalls that three decades ago, Australian farmers and scientists were in the same situation and were equally sceptical. As the Iraqis were encouraged to experiment, gradually the technique proved itself.

“The results surprised the Iraqis,” Dr Piggin says. “Yields were found to match or excel fully ploughed plots despite requiring less labour and inputs, such as fuel. The technique provides a lot of efficiencies, including in the amount of water needed since the retention of stubble helps retain soil moisture that can see a crop through in a dry year.”

Since the technique requires specialised sowing machinery that drills through stubble to deposit seed, seeders were bought from India. When these proved too small for Iraq farming practices, local seeders were modified and used in field trials in two different rainfall locations where maximum yields rose to 1.8 and 1.9 tonnes a hectare respectively.

“Sowing in Iraq is often done by village contractors who service 50 to 100 farmers,” Dr Piggin says. “That centralisation means when they use zero-till, adoption of conservation cropping can spread quickly.”

While visiting researchers in Australia in 2008, Dr Saleh Bader from Iraq's Ministry of Agriculture confirmed that the technique is being adopted widely by Middle Eastern farmers.

“We look to Australia as excellent partners and the Australians have very good technologies for zero-till and the conservation of cropping,” he said. “It is very important for us to develop the capability of the farmers and the people of the region.”

The project's success has resulted in extension activities and plans for a follow-up project that retains farmers at the heart of efforts to develop and distribute cropping options throughout the north's dryland cropping system.

ICARDA will again lead the project, with day-to-day management in Iraq undertaken by the University of Mosul's College of Agriculture and the Ministry of Agriculture, through the SBAR and the Ninevah Directorate of Agriculture. ■