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IN RESEARCH FOR DEVELOPMENT



**Boomerang
research**

— PAGE 3

**Forestry
innovations
branch out**

— PAGE 10

**Improving
digital farm
services**

— PAGE 20

About Partners

Partners in Research for Development is the quarterly publication of the Australian Centre for International Agricultural Research (ACIAR). *Partners* presents articles that summarise results from ACIAR-brokered research projects and puts ACIAR research initiatives into perspective.

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Front cover: ACIAR-supported research is helping restore coral on the Great Barrier Reef. Photo: Juergen Freund (page 3).

Back cover: Citrus orchard in Australia. Photo: Citrus Australia.

Erratum: *Partners* Issue 3, 2020. Page 3 photo was incorrectly captioned. The correct name of the person featured is Ellen Emolaga. Pages 8 and 9, project managing agency was incorrectly named. The correct name is Applied Horticultural Research.



3



8



16



22

inside

ISSUE FOUR 2020 | PARTNERS

- 2** From the CEO
- 3** Boomerang research
- 6** Defining innovation to focus on impact
- 8** Controlling fish sex nets industry boon
- 10** Forestry innovations branch out
- 14** Fiona Simson: being a good neighbour is a win-win
- 16** Cultivating Africa's Future Fund: innovation through partnership
- 20** Connecting the dots improves digital farm services
- 22** 'Micro' mechanisation rolled out

From the CEO

Professor Andrew Campbell



This issue of *Partners* is the first under our new Commission for International Agricultural Research. I am delighted to welcome new fellow Commissioners who have recently been selected by the Minister for Foreign Affairs, Senator the Honourable Marise Payne.

The new Commissioners bring tremendous Australian industry leadership experience, particularly through the new Chair Fiona Simson and Tony York. They also bring considerable CGIAR leadership experience. Professor Lindsay Falvey is the Chair of the International Livestock Research Institute, and Dr Beth Woods has previously chaired both WorldFish and the International Rice Research Institute.

The Commission has a good blend of new Commissioners and continuing Commissioners. Ongoing Commissioner Su McCluskey is also a member of Australia's National COVID-19 Commission, providing an excellent link with our own COVID-19 response. While Dr Sasha Courville is involved in leading response work in the corporate sector as Executive, Social Impact at National Australia Bank.


The second stage of the ACIAR assessment of the impacts of COVID-19 on food system risks and resilience is a significant strategic element of our response to the pandemic. Our partners the Australian National University and CSIRO stepped up very rapidly to take on this work, alongside in-country partners. This collaborative effort once again illustrates how the ACIAR partnership and strategic commissioning model can deliver strategic value, helping us to tackle problems collectively that span national borders and affect everyone.

The ACIAR Annual Report 2019–20 has been tabled in the Australian Parliament. It summarises our annual performance, and producing it is one of our statutory requirements. While it has been a tumultuous year, the report demonstrates the continuity of ACIAR research, business and services. We will soon be releasing our Annual Review, which is our more

engaging review of last year, aimed at a wide public audience, and our Annual Operating Plan, which is our forward-looking plan for the upcoming year.

Innovation—translating knowledge into impact—can deliver meaningful interventions to solve such challenges. ACIAR doesn't fund research for research's sake. We are interested in finding the best pathway to impact in a given context, and innovation often forms a part of that.

The diversity of examples illustrated in this issue demonstrates that innovation is not just a fancy widget or smart phone app. You can have innovation in partnership and governance models. You can also have innovation in a supply chain organisation. There's a rich diversity of innovation across the ACIAR portfolio. Sometimes there will be a commercialisation pathway, and sometimes there will be a market chain, policy or regulatory pathway.

We work with both the private and public sector to innovate because both are important in delivering global public goods like poverty alleviation, food security, prevention of diseases like COVID-19, or climate change mitigation and adaptation. 

A handwritten signature in black ink that reads "A. Campbell".



Boomerang research

From a fragrant citrus orchard on the edge of Australia's outback to the glistening waters of the Great Barrier Reef and across to the wide expanse of western Australia's wheatbelt, ACIAR research—despite its mandate to reduce poverty and improve livelihoods in its partner countries—continues to provide benefits back home.

ACIAR CEO Professor Andrew Campbell says 'first and foremost, we commission work against the objectives of Australia's aid program that overlaps with the priorities of ACIAR partner countries.

'Nevertheless, lots of work that we do is also relevant in Australia, and there's a benefit flow-back to Australia.'

Professor Campbell adds that beyond the tangible benefits of innovations developed overseas being brought back to Australia, the personal benefits and enhanced capacity for Australian researchers who work on ACIAR projects is profound and long-lasting.

'I think that's an enormous value-add for the Australian innovation system,' he says. 'A number of senior people in Australian science have said to me that early in their career, they were lucky to work on an ACIAR project, and they learned more from that international experience in a developing country than they have in anything ever since. It's had a lasting impact on their career.'

ACIAR research innovation affects Australia in a myriad of ways. *Partners* explores three examples that span different sectors and different approaches to innovation.

Key points

- 1 ACIAR invests in international agricultural research to benefit its partner countries, but Australia directly benefits from it as well.
- 2 Citrus and wheat research has helped support disease preparedness and introduce new breeding lines for Australia.
- 3 Coral restoration techniques developed in an ACIAR project in the Philippines are being applied on Australia's Great Barrier Reef.



Dr Dexter Dela Cruz (l) and Professor Peter Harrison (r) are applying coral restoration techniques developed through an ACIAR project in the Philippines on the Great Barrier Reef. Photo: Juergen Freund.

Restoring Australia's Great Barrier Reef

Australia's Great Barrier Reef—the largest reef system in the world—is the latest beneficiary of an ACIAR-funded project. Through coral research carried out over three years in the Philippines, the project has developed coral reef restoration techniques that are now being applied and scaled out to help the reef recover from devastating bleaching events.

The chances of a microscopic baby coral larva surviving are one in a million. Yet coral reef systems depend on coral larvae settling onto reefs, changing into a baby polyp form, and surviving to maturity.

To help boost the chances of coral larvae surviving, project leader Professor Peter Harrison from Southern Cross University, has developed a technique that starts by capturing millions of coral eggs and sperm during natural spawning events.

Professor Harrison and his partners then propagate the coral larvae in tanks onshore and, later, in contained floating pools on the reef. When they are



about a week old and ready to settle, the coral larvae are put back out on the reef and protected with fine nets to hold them in place. Once larvae have settled, the nets are removed and the coral fends for itself.

'In the Philippines we're getting about one adult coral from every 20,000 larvae that we're settling on the reef,' says Professor Harrison.

'In the early trials on the Great Barrier Reef, we were getting around one adult coral after a few years from about 10,000 larvae.

'We've achieved a world record by establishing the fastest-growing individual colonies that get to breeding size in two years.'

Professor Harrison credits 'some very enlightened individuals in ACIAR' for first recognising the potential of his work when he could not get other local sources of funding. 'ACIAR saw that the coral restoration approach was sufficiently innovative and had a great potential for scaling up, and if it worked it would be really important for recovering reef communities.'

In the early reef trials in the Philippines, reef areas up to an Olympic-sized swimming pool size were successfully re-seeded with coral through the technique. More recently, Professor Harrison has partnered with Professor Matthew Dunbabin from the Queensland University of Technology to test run an underwater robot—LarvalBot—to re-seed the coral over larger areas.

'We delivered a few million larvae over three one-hectare plots in the Philippines in 2019 and showed the potential for much larger scale delivery in the future,' says Professor Harrison.

More partners are now getting on board, with support to expand the research coming from the Great Barrier Reef Foundation and the local tourism industry, who are encouraging tourism operators and local communities to work alongside scientists to help collect spawn and support the restoration work.

This work will run alongside another follow-on ACIAR-supported project that will look at scaling the work out in the Philippines.

New wheat traits fast-tracked

Wheat is one of the most important crops in Australia. It is also important to ACIAR partner countries—particularly countries in South Asia.

Through an ACIAR project with India, new breeding material has been introduced to Australia, where it is being used to breed new, hardier wheat varieties suitable for Australian conditions. In India, use of the material has already resulted in new varieties.

Professor Richard Trethowan, from the University of Sydney, led the India-Australia program on marker-assisted wheat breeding to develop and use wheat molecular markers that flag the location of desirable genes. Knowing the location of desirable genes can speed up the breeding process significantly, helping to get new wheat varieties to farmers faster.

In collaboration with Indian partners, Professor Trethowan crossed the best Indian and Australian wheat to generate new breeding material.

'In India, the material is now integrated into their breeding programs. They've released cultivars from it,' says Professor Trethowan.

Since the end of the project, the material has been used by commercial breeding companies in Australia who develop new wheat varieties in the country.

'By the end of 2017, 188 Indo-Australian lines were accessed by the main commercial breeding companies in Australia,' says Professor Trethowan.

'They came and saw them in the field trials that we had established in different locations and they looked at our supporting data.

'I asked them what they planned to do and they indicated they would put the lines into their



Australian breeders, grain growers and agricultural consultants inspect new wheat breeding material, introduced to Australia as part of an ACIAR project, at a field trial in Narrabri. Photo: Sydney University.



early-stage yield-testing and cross them with their own material.'

In Australia, companies rarely release an introduced wheat breeding line as a commercial variety. Instead they tend to cross them with their own lines to produce a unique variety with appropriate quality characteristics that they can then commercialise.

Of interest to the breeders was the breeding lines' improved resistance to plant rust diseases—a perennial problem for Australian farmers.

According to Professor Trethowan, given the time it takes to breed and commercialise new wheat varieties it will be a few years yet before the impact of the ACIAR research starts to benefit Australian farmers. 'We are probably looking at an impact in the pedigrees of commercial cultivars being released in Australia from about 2023 onwards.'

In follow-up work Professor Trethowan reviewed thousands of wheat breeding lines for heat tolerance—including those from India. 'We have identified 27 super progenitors for heat tolerance that have come from the material imported from India as a result of the ACIAR project,' he says.

Improved heat tolerance can help wheat to cope with Australia's regular droughts and high temperatures. This material has likewise been picked up by local breeders.

Building capacity in citrus

ACIAR investment in citrus improvement research over 20 years has demonstrated substantial benefit to Australia as well as China, Vietnam and Bhutan.

An impact assessment study of four ACIAR-supported projects on citrus improvement found economic, social, environmental and industry benefits from a A\$3.2 million ACIAR investment between 1993 and 2013.

Projects in China and Vietnam had helped to preserve citrus genetics, facilitate the transfer of technologies from Australia to deliver disease-free planting material, build science capacity and introduce more profitable varieties.

In Bhutan, the work supported the establishment of a citrus research and extension team, and implementation of improved production measures for large and small mandarin growers. This has seen smallholder income for mandarin growers in Bhutan double.

For Australia, the introduction of Chinese citrus rootstocks was 'substantial' thanks to its delivery of disease-free planting material to the Australian industry.

Dr Nerida Donovan, a citrus pathologist with the New South Wales Department of Primary Industries (NSW DPI), was one of the Australian researchers supporting the work in Bhutan. Dr Donovan focused on the disease aspects of projects—including identifying diseases and supporting prevention.

Project knowledge, techniques, technology and equipment were among the resources shared between Bhutan and Australia. And the benefit flowed both ways, with Dr Donovan and other researchers building their knowledge of diseases relevant to the Australian citrus industry.


'There are a number of pests and diseases of citrus that are not found in Australia but can be found in ACIAR partner countries,' says Dr Donovan. 'It is important that we see these diseases and pests—not only to recognise what they look like but to learn how the local people have managed them for hundreds of years.'

'If we get a sample in Australia which is suspected to be an introduction of a new disease, it helps if I have actually seen the symptoms.'

Recognising the symptoms quickly increases the likelihood of eradicating the disease and enables Dr Donovan and her team to respond with more confidence to risk in Australia's citrus industry.

All diseases are also confirmed via laboratory tests. Through Dr Donovan's work, diagnostic testing has been improved and applied in Australia.

For Dr Donovan the added value of partnering with ACIAR has been to maintain essential citrus research knowledge in Australia. The NSW DPI team is the only multi-disciplinary government team in Australia dedicated to citrus, and during a period when local citrus funding was limited, ACIAR supported it.

Today, a greater awareness exists of the role international research can play in supporting Australia's industry. The citrus research levy has increased, priorities have changed and key industry players are becoming actively involved in discussions to shape future ACIAR-funded citrus projects. 

ACIAR PROJECTS:

- Restoring damaged coral reefs using mass coral larval reseedling, FIS/2014/063
- Molecular marker technologies for faster wheat breeding in India 2, CIM/2013/009
- Adapting integrated crop management technologies to commercial citrus enterprises in Bhutan and Australia, HORT/2010/089



Defining innovation to focus on impact

Dr Daniel Walker, Chief Scientist, ACIAR

Try entering innovation into Google. Beyond it being about something new, see if you can make sense of the results you get.

We use the word *innovation* to describe a product ('here's the latest innovation from...'), a process ('that's when the innovation happened'), a role ('innovation broker') and even an experience ('feel the innovation!').

While some words are very stable in their meaning, others, like *innovation*, change and accumulate meanings as people attach new ideas and roles to them. In 16th-century Europe, innovation was all about dangerous religious or social change and could get you into a lot of trouble. That's very different to the

current use of the word innovation: dynamic, positive and a force for good. For some, innovation has become a cultural aspiration with its own language ('ideation', 'disruptor', 'pain points'), symbols (t-shirts and funky offices) and superstars. That's the nature of language.

We use words like innovation, resilience, sustainability and transformation a lot in our research. They feel intuitive but their meanings turn out to be slippery. And that can get in the way of both good science and clear communication.



The uptake and use of the Chameleon Water Sensor—which is helping these smallholder maize farmers in Malawi and members of the Virtual Irrigation Academy to improve water management—is a sign of innovation. Photo: Richard Stirzaker, CSIRO.



What does innovation mean to ACIAR?

I can't remember who said 'Research turns money into ideas. Innovation turns ideas into money' but if you substitute 'impact' for 'money' in the second sentence, then it seems to me that you have a nice definition of 'research for development'.

Converting money into ideas into impact is core to the mandate of ACIAR. Just turning money into ideas is not enough for us. Innovation is a critical step.

My wordier definition for innovation is this: the process of creating value by applying knowledge or technology to a challenge in a novel way. This is a step in a chain. Discovery science creates new knowledge or insight. Invention creates new technologies based on that knowledge. Innovation can then generate value from that new knowledge or technology. And finally, in a development context, scaling of that innovation can deliver development impact.

Innovation doesn't just happen by accident. The vitality of an innovation system determines how effectively the whole process works. Many private- and public-sector organisations—including ACIAR—think carefully about how to invest in individual, organisational and system capacity to improve innovation outcomes.

Innovation and ACIAR projects

ACIAR research projects have a clear responsibility for the research steps of discovery and invention, albeit always building on prior knowledge and technologies. Most projects also have an important role to play in capacity building. But do ACIAR projects 'do' the innovation or do they 'enable' innovation by others? The answer is both.

Dr Richard Stirzaker at CSIRO applies soil physics to help us understand whether soil moisture is available to plants. He has applied that science to inventing

the Chameleon sensor that measures whether soil moisture is inadequate, adequate or excessive for crop growth. But it's the way that smallholder irrigators use this invention that allows farmers to reduce water use, increase crop yields, reduce risk and free up time. And it's the way the people who manage and develop irrigation schemes use the data created that allows us to get more out of precious water and finances.

Rather than just rely on the invention of the Chameleon, Dr Stirzaker has created the Virtual Irrigation Academy (www.via.farm). The academy supports a global community of people discovering how to use the Chameleon and related technology to manage water to grow more food.

Planning for innovation

The ACIAR project proposal template asks teams to summarise intended project outcomes—the changes to knowledge systems or practices that the project intends to contribute to during the project. Specifically, we ask proponents to tell us: If the project is successful, who is going to be able to do what differently?

We then ask them to expand on this under three headings:

- Scientific achievements: What will we know or be able to do that we don't know or can't do now? What future research and innovation will this enable?
- Capacity built: Who will be able to do what differently?
- Next users and innovation enabled: Who (excluding the project team) do you expect will do what differently and what value will this create?

You might think this implies that ACIAR project teams do the science and hope that others create the value from that science. In fact, a lot of ACIAR project work applies existing knowledge and technologies to new contexts to tackle defined issues—in other words, innovation.

It is also true that sustained value is only ever likely where others create opportunity and value from what comes out of that project work—again, in other words, innovation. So, innovation is core to the ACIAR partnership model and partnership is core to the ACIAR innovation model.

So there you have it. My definition for innovation is 'the process of creating value by applying knowledge or technology to a meaningful challenge in a novel way'. In ACIAR this means working with the people who can create value from our research. 🌱

Key points

- 1 ACIAR targets innovation through its projects by applying existing knowledge and technologies to new contexts to tackle defined issues.
- 2 Innovation is core to the ACIAR partnership model and partnership is core to the ACIAR innovation model.

Controlling fish sex nets industry boon

Sitting down for a meal at a local eatery in Vietnam often means having the chance to choose a live fish from an aquarium. The chance one of these fish is a hybrid grouper has increased significantly over the past 10 years thanks to an ACIAR-supported project that has found better ways to breed and rear the fish locally.

The secret has been in developing hormones that trigger sex changes and spawning in the parent fish. The application of these innovations by the Vietnam Government has initiated changes across the industry, boosting fish production and farmer incomes.

Hybrid grouper

A mix of different grouper species is farmed in Vietnam, including tiger, orange-spotted, giant and red grouper. But hybrid grouper—produced from a male giant grouper and a female tiger grouper—is among the most popular.

The reason for this, explains project partner Dr Truong Quoc Thai, Director of Nha Trang Marine Research and Development Center, is because it inherits valuable traits from the male giant grouper, such as fast growth, good meat quality and beautiful coloration, while retaining the resilience of the female tiger grouper.

According to Dr Truong Quoc Thai, farmers can also sell their hybrid grouper at a much higher price than giant grouper.

Key points

- 1 Hybrid grouper farming in Vietnam has increased substantially off the back of ACIAR-supported research.
- 2 Fish farmers can now source locally-bred juvenile hybrid grouper that are more resilient and productive.
- 3 Cited as good to eat and attractive, the hybrid grouper can also deliver higher returns to farmers.

Industry limitations

However, breeding and raising young hybrid grouper is not easy. Vietnam had been almost entirely dependent on importing fingerlings because it did not have the capacity to breed and raise the hybrids itself.

For fish farmers like Mr Le Kim Hoa from Cam Ranh, this meant depending on imported fingerlings and broodstock from Taiwan, China and Indonesia. 'The fingerlings' survival rate was low because we could not control the quality of the fingerlings and the diseases that came with importing fish,' he says. Imported fingerlings—some of which became breeding stock—also had limited genetic variability, meaning they were more vulnerable to diseases.

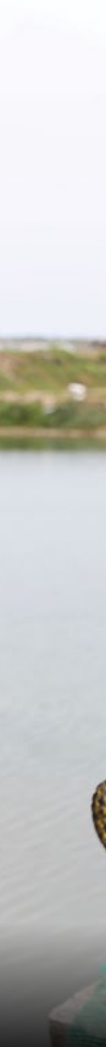
It was here that the ACIAR-supported project led by Professor Abigail Elizur of the University of the Sunshine Coast started its work. The six-year project set out to help Vietnam develop its capacity to breed, rear and grow-out its own hybrid grouper.

Creating small fathers

As the first step, sperm from a male giant grouper is needed. All giant grouper start life as female and can grow to a massive 100kg over seven years before they transition to being male. Keeping a fish this size, let alone handling it to extract sperm, is a real challenge, explains Professor Elizur.

Through the project, the research team identified how to cause the fish to switch to being male earlier and on demand.

'We found that some of the giant grouper would actually turn into males when they were younger and in the right social environment—that is, in small groups where males were absent. Others would transition into males in response to a hormonal manipulation,' Professor Elizur says.





Fish farmer Nguyen Tan Phuong with one of his hybrid grouper that are now bred locally in Vietnam, helping to develop the local industry. Photo: Vu Khanh Long.

'In this way you can have a male that's about 10 kilos—and that is incredibly significant.

'You can envisage the difference between holding a male of 100 kg or 150 kg and 10 kg. It is a very different logistic proposition.'

Vietnam, through its government-funded fish breeding facilities, has since successfully adopted these practices. This has made it easier and more efficient to farm and harvest the sperm of the giant grouper.

Triggering the mothers

On the other side of the equation is the female tiger grouper. The challenge here was to get the female to spawn—or release its eggs—when required so they could be fertilised.

In response, Professor Elizur developed a specialised hormonal treatment that could be administered orally or by injection to the female tiger grouper.

'We give them a slow-release hormone that we prepared ourselves,' says Professor Elizur.

'We have also developed oral delivery protocols for the hormones so that when we want to induce the spawning, we don't have to bring the whole tank down, and we're talking tanks with 80 to 100 tonnes of water.'

The technologies have been adopted locally, and since the project ended in 2019, local project partners Vietnam's Research Institutes for Aquaculture No. 1 and No. 3 have become leading suppliers of hybrid grouper eggs and juveniles for hatchery farms in Vietnam.

Growing the industry

The locally-bred juvenile hybrid grouper now meet 75% of domestic demand and hybrid grouper farming has expanded. For example, in Khanh Hoa province, hybrid grouper farming accounted for around 70% of total grouper production in 2019, up from less than 5% in 2013.

Mr Hoa says there are many benefits of buying juvenile grouper locally. 'The survival rate is up to 80–90% and the short culture time of the hybrid grouper yield high profits,' he says. He also saves money on transporting the juveniles.

Professor Elizur says that 'the market is far from saturated' and there are more opportunities for the industry to grow and meet demand on the back of the enhanced local capacity to produce the fingerlings.

High-tech platforms for innovation

Professor Elizur emphasises the value of high-tech approaches that support smallholder farmers.

In Vietnam, the farmers themselves don't typically produce the juvenile fingerlings nor apply the knowledge from this project. However, the application of the technology which is giving them access to locally produced, high-quality fingerlings has provided the innovation platform upon which they have benefited.

In some cases, fish farmers' incomes have doubled as a result of growing out locally-produced hybrid grouper. The project has also helped shift pressure away from wild-caught grouper to farmed ones. 🌱

ACIAR PROJECT: Developing technologies for giant grouper aquaculture in Vietnam, the Philippines, and Australia, FIS/2012/101.



Forestry innovations branch out

From combatting illegal logging to adding value to old coconut palms to support industry rejuvenation, ACIAR research is delivering innovative solutions to smallholder forest owners.

'Biophysical and social innovation is critical to addressing challenges we face in creating, restoring, managing and protecting forest resources for human benefit,' says Dr Nora Devoe, ACIAR Forestry Research Program Manager.

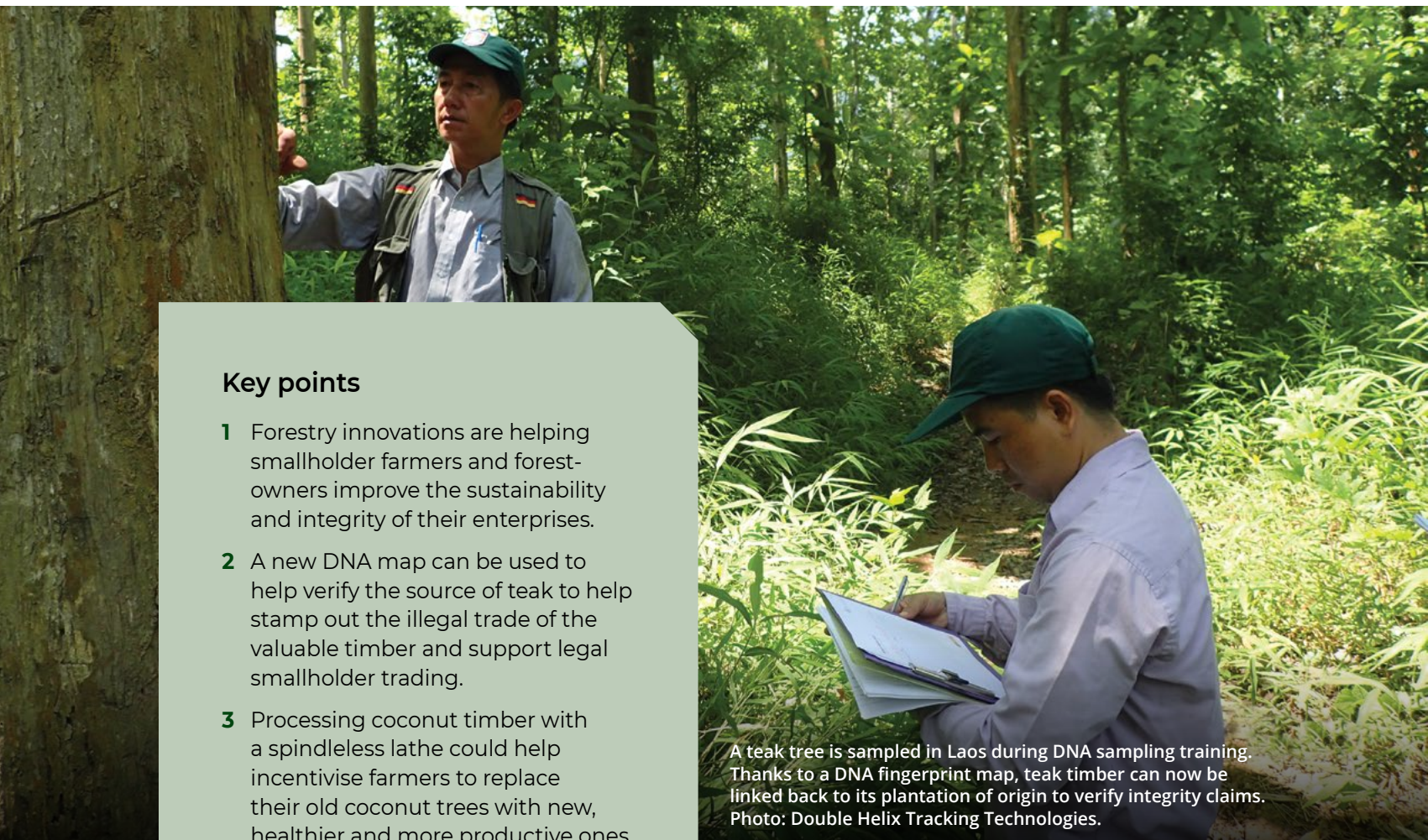
Two ACIAR projects show how forestry innovations can have an impact and support better environmental and economic outcomes.

The first is providing a way to track the origin of teak timber to ensure it comes from legal sources. The second is working with smallholder coconut farmers to process their old coconut trees for an economic return and as an incentive to renew their plantations with newer, healthier trees.

Teak 'fingerprints' thwart illegal trade

ACIAR research has successfully developed cost-effective DNA tests for one of the most valuable timbers in the world: teak. This brings authorities a step closer to shutting down the illegal trade in timber from South-East Asia and the Pacific region.

Samples of teak sent to the University of Adelaide were used to develop a DNA reference map of genetic variation for the valued species. Samples were sourced from natural forests in Myanmar, Laos and Thailand, and plantation teak forests in Laos and Indonesia. Work is underway to apply the same process in Solomon Islands and Papua New Guinea.



Key points

- 1 Forestry innovations are helping smallholder farmers and forest-owners improve the sustainability and integrity of their enterprises.
- 2 A new DNA map can be used to help verify the source of teak to help stamp out the illegal trade of the valuable timber and support legal smallholder trading.
- 3 Processing coconut timber with a spindleless lathe could help incentivise farmers to replace their old coconut trees with new, healthier and more productive ones.

A teak tree is sampled in Laos during DNA sampling training. Thanks to a DNA fingerprint map, teak timber can now be linked back to its plantation of origin to verify integrity claims. Photo: Double Helix Tracking Technologies.



Supporting sustainability

Completed in 2018 and on the back of two previous projects, an ACIAR small research activity aimed to reduce the trade in illegal timber for the economic benefit of producer countries and to improve the long-term sustainability of teak production.

Project leader, Professor Andrew Lowe from the University of Adelaide, says the DNA tracking will help to reduce the A\$42.8 billion illicit trade of teak.

Verifying the paper trail

Project partner Double Helix Tracking Technologies, organised the sampling in Myanmar through local forestry partners and trained workers to take the tree samples and geo-reference each log.

Double Helix Chief Executive Officer, Mr Darren Thomas, says Myanmar foresters had very good forest management and paper documentation practices to authenticate the source of teak but the global movement of illegal timber made further assurance necessary.

‘One of the primary ways that illegal timber enters the market is through being mixed into legitimate supply chains, accompanied by fraudulent documents,’ Mr Thomas says.

‘Teak logs confiscated from illegal logging groups are resold into the market rather than destroyed so this has become controversial for customers in the European Union (EU), which requires illegal timber to be excluded from supply chains completely.

‘While mixing of legal and confiscated timber can be controlled in certified supply chains, the EU has raised doubts as to the reliability of paper verification.’

The DNA map shows at least five distinct genetic clusters for teak in Myanmar. Allowing for a 100 km tolerance, this DNA map accurately traced back 99% of blind-test samples to their claimed origin.

‘The Adelaide laboratory also applied DNA fingerprinting methods to match those blind samples of sawn timber from the log yard and cut tree stumps, and accurately traced each piece of timber to its individual tree stump in the forest or plantation,’ says Mr Thomas.

‘In Myanmar, forestry is an important source of foreign income, so this is a powerful means of restoring trust and confidence in the system.’

While DNA testing has become more cost-effective to support document verification audits, Mr Thomas says it’s not necessary to run tests on every shipment of timber.

‘For a consignment of sawn teak worth A\$280,000 the DNA testing costs A\$5,500 so it’s a case of figuring out how often that needs to be done and for what level of sales to sustain confidence in the system and encourage legal trade,’ he adds.

Results of the project were delivered at workshops in Indonesia, Myanmar, Solomon Islands and Laos, and training in field and laboratory procedures was provided to project partners from Indonesia, Laos, Papua New Guinea, Solomon Islands and Myanmar.

Extending the knowledge

Mr U Mehm Ko Ko Gyi from Myanmar’s Ecosystem Conservation and Community Development Initiative says while the DNA chain of custody will make a big difference to the local timber industry, more samples need to be collected and tested to extend the teak map across all parts of the country.

Professor Lowe says a follow-up study would also be useful to develop DNA testing methods for application in Myanmar laboratories with different technical capabilities.

“This is a powerful means of restoring trust and confidence in the system.”

Darren Thomas, Double Helix Tracking Technologies.

A DNA chain of custody system could also be designed to support a simplified, low-cost certification or third-party verification program to support smallholders’ sale of timber from community forests into higher-value markets.

In Indonesia, DNA was used to trace teak timber along a large plantation supply chain from the Perhutani Forest Management Unit at Cepu.

‘We trialled two methods that worked for large-scale industrial state-owned plantations in Indonesia—the first to check that logs at different points in the supply chain came from the same tree, which proved 90% accurate,’ Professor Lowe says.

‘The second tested whether logs matched the genetic profile of their source plantation and this was 100% accurate, and that’s what we recommend for large-scale and smallholder plantations.’

DNA tracking has previously been used in the USA to successfully prosecute the illegal trade in bigleaf maple. It is hoped this teak DNA map will be used in the same way to abolish illegally traded teak and support a sustainable teak supply chain.



Good wood from old, skinny coconuts

To produce wood veneer from old coconut palms and other small-diameter trees, a new ACIAR project is investigating the use of spindleless lathes. The technology has the potential to rejuvenate the timber industry in the Pacific region and provide farmers and forest owners with a new opportunity to gain value from trees that are often wasted.

The project will also provide owners of ageing coconut plantations with the incentive to replace their declining palms with new and better varieties. This can reduce pest and disease threats, increase yields and ensure a sustainable resource for the future.

Director for Timber Utilization and Research Division at Fiji's Ministry of Forestry, Mr Tevita Bulai says that all parts of the coconut are useful, but senile coconuts older than 60 years are less productive. 'They only produce 10 coconuts a year, or none at all,' he says.

Coconuts are pivotal in the livelihoods of smallholder farmers in the Pacific region. Coconut consumption per capita averaged 2.84 kg worldwide in 2017, while in Fiji it was 61.2 kg. Coconut water and other coconut products such as copra and oil are key sources of income as well as nutrition. The palms also supply roof thatching, flooring and framing; materials for implements such as fish traps, baskets, and cordage; and shading for other food and cash crops.

Unsuited to traditional methods

The use of traditional wood sawing and processing systems to convert the stems of old coconut palms into high-value wood products for use in flooring and furniture has been largely unsuccessful due to the narrow trunks and composition of the plant.

Unlike trees which grow up and outwards, increasing their diameter and adding a new layer of wood each year, coconut palms grow upwards like grass and never achieve diameters above about 300 mm. This is a real challenge for traditional sawmilling and veneer processing equipment.

While the outside of a 60-year-old palm can be as dense as 1,000 kg/m³, the middle is a very soft 250 kg/m³.

Project leader Dr Rob McGavin, from Queensland's Department of Agriculture and Fisheries (QDAF), says it is very difficult to recover the more attractive, higher density part of the log into sawn timber, with this part of the log often wasted in the conversion process.

Rotary peeling has the potential to recover this valuable part of the log, however traditional



High-quality, high-value engineered wood products made from coconut veneer have been made possible thanks to spindleless lathes. Photo: Rob McGavin.

approaches use spindles to hold the centre of the log and rotate to allow the log to be unrolled. The problem is that these spindles just don't work with the soft centre of coconut stems.

Spindleless lathes

Spindleless lathes have drive rollers that run on the log periphery for the length of the log and combine with a parallel blade to 'unroll' or peel it in a 3–5 mm sheet, leaving a residual core of about 40 mm.



Spindleless lathes are helping smallholder forestry owners in the Pacific region recover more coconut timber and secure better returns. Photo: Rob McGavin.

'This means we can recover around 70% of the stem from a senile coconut palm, compared to 20% or less using other options,' says Dr McGavin.

'The result is a high-quality veneer that can be used for the manufacture of structural and appearance engineered wood products.'

Other trees with small diameters, including those thinned from plantations, can be processed in the same way. This adds value and incentivises better forest management.

The five-year project is a partnership between ACIAR, QDAF, Fiji's Ministry of Forestry and the Pacific Community (SPC). It also has four Australian forestry industry partners, including the Big River Group at Grafton, New South Wales. It builds on the work of two previous ACIAR projects with partners.

Beautiful and potentially valuable

Dr McGavin says coconut palm wood has a unique grain with a gold to dark-chocolate fleck. Coconut veneer or 'cocoveneer' is usually 3–6 mm thick and can be used in architecture, furniture and joinery, as well as structural plywood, packaging and high-quality laminated veneer lumber.

The direct return to farmers from the sale of senile coconut stems is expected to be small initially. However, once coconut-based engineered wood products are commercially produced, demand is expected to regularly supplement farm income within the economic haul distance of manufacturers.

The greater economic impact will be in the increased profitability of coconut-growing from renewing coconut stands with younger, more genetically diverse, resilient and productive coconut varieties. This will help improve the incomes of more than half a million households in the Pacific region that grow coconuts.

Growing from here

'Spindleless lathes can be purchased for a fraction of the cost of traditional veneer lathes so this has great potential for widespread adoption in many developing countries,' Dr McGavin says.

In Fiji there are already three registered veneer mills. The Ministry of Forestry wants to see collaboration between the industry and resource owners to process senile coconuts and other small-diameter logs into structural and engineered wood products.

'We have enough capacity in terms of timber mills to process cocoveneer,' says Mr Bulai. 'I think this technology will mean an improvement in livelihoods especially for rural communities. The technology can be easily set up and easy to operate with less waste.'

There is also work to be done to build a skilled labour force to operate the lathes and develop cocoveneer markets. Dr McGavin also wants to better understand farmers' perceptions about cutting down their oldest trees and waiting 6–7 years for new trees to fruit. Past incentive programs have encouraged farmers to replant with new and better varieties, but the success of many have been limited.

'By providing a revenue stream for farmers through the sale of senile palm stems, this project will hopefully provide encouragement to remove older, less-productive stems and offset the costs of replanting,' Dr McGavin says.

The project is scheduled to start before the end of 2020. 🌿

ACIAR PROJECTS:

- Developing DNA-based chain of custody systems for legally-sourced teak, FST/2016/025
- Coconut and other non-traditional forest resources for the manufacture of engineered wood products, FST/2019/128



Fiona Simson: being a good neighbour is a win-win

Fiona Simson's enthusiasm for her new role as Chair of Australia's Commission for International Agricultural Research is obvious—and infectious.



Ms Fiona Simson

Speaking via video call from the verandah of her home in rural New South Wales, she is clearly inspired by the outcomes ACIAR projects generate.

'I've long been impressed by the work of ACIAR. For an organisation of its size, with a relatively small budget, its impact—the positive outcomes it generates—is incredible,' says Ms Simson.

'The model is a win-win. We share the knowledge of our world-class research institutions with farmers in developing countries to build their capacity and ability to be self-sustaining. It is so powerful.'

A farmer—in partnership with her husband Ed—Ms Simson is the first female President of Australia's National Farmers' Federation and is leading the organisation and industry through a significant period of change.

'Farming is an industry of the future, and through collaboration and innovation, we can ensure it's sustainable,' she adds.

Ms Simson first experienced the value of supporting farmers in developing countries with the World Farmers' Organisation years ago, and a project that targeted women farmers in Zambia.

'The project worked with these farmers, educating them about how to grow a more productive crop for their family, but also enough for one more family,' says Ms Simson.

'Seeing the outcome of this first-hand was incredible. It's not just a one-off injection of cash but creating long-term, sustainable change and improvement in the lives of these women and their families.'

Ms Simson says the opportunity to contribute to ACIAR and be part of an organisation fully focused on such outcomes was too good to pass up.

'I'm thrilled to be given the opportunity to be involved. The positive outcomes of sharing targeted research and development with developing countries are significant.'

Ms Simson is quick to point out that Australia's agricultural research and development talent and institutions are among the world's best.

'But what makes us different? I think the challenging nature of farming in Australia has fostered research and development that's practical,' she says.

'ACIAR is central to the transfer of that innovation in ways that work on the ground in developing countries. To share what can make such a difference at a local and regional level.

Key points

- 1 Newly appointed Chair of Australia's International Commission for Agricultural Research, Fiona Simson, says there is an opportunity to raise the profile of ACIAR among Australian farmers.
- 2 Working with ACIAR partner countries is mutually beneficial, helping farmers and improving the health of agriculture more broadly.



Mutual benefit

'Being a good neighbour' is part of Australian agriculture's culture, and farmers understand the benefits that flow both ways from providing practical support, Ms Simson says.

'Yes, ACIAR work helps our neighbours, but it's a mutually beneficial arrangement.

'The capacity and capability of these farmers plays a vital role in the health of agriculture in our region.'

'I've long been impressed by the work of ACIAR. For an organisation of its size, with a relatively small budget, its impact—the positive outcomes it generates—is incredible.'

Fiona Simson

As examples of the benefits of regional collaboration, she points to the essential labour that seasonal workers from ACIAR partner countries provide Australian farmers—'never before has this been more apparent than in 2020'—and the importance of a regional approach to maintaining the biosecurity shield that protects Australian agriculture.

'Through working together, we can achieve more and better outcomes for all,' she says.

Future focus

Diversity was a focus of the previous Commission and one Ms Simson says is worthy of continued prioritisation.

Ms Simson has long been a strong advocate for promoting and celebrating diversity in Australian agriculture. In 2018 she was instrumental in the launch of the National Farmers' Federation's highly successful Diversity in Ag Leadership Programme which seeks to encourage more women and young people into agriculture.

'Women play a significant role in agriculture throughout the Indo-Pacific region. We need to understand and acknowledge that role and consider how our projects can best support that,' she says.

Ms Simson also sees alignment between the Commission and her role as President of the National Farmers' Federation.


'I think there is an opportunity to continue to raise the profile of ACIAR among Australian farmers and explore whether there is a logical step to build even closer links with targeted research projects that involve our farmers, too.'

What's first?

At the time of writing, the new Commissioners had met just once and Ms Simson says, first and foremost, they are keen to understand how the coronavirus pandemic is affecting ACIAR operations.

'Naturally there has been some impact on the ability of people to travel but we've been really impressed to see that the switch to the virtual environment has been a relatively smooth one for ACIAR.'

Ms Simson says having people in-country has been key to this transition and acknowledges the significant adaptability of the Australian-based team.

'While I'm really keen to see some of these projects first-hand, it's a credit to the ACIAR team to know their good work, and the contribution that Australia is making through sharing agricultural research and development in developing countries, is on-going despite the impact of COVID.' 

ACIAR welcomes new Commissioners

Four new and three reappointed Commissioners now form Australia's Commission for International Agricultural Research.

Australia's Minister for Foreign Affairs, Senator the Hon. Marise Payne, selected the appointments.

The Commission provides expert, strategic advice to the Minister on priorities for Australia's international agricultural research program—particularly the work of ACIAR.

The Commission now comprises:

- Ms Fiona Simson (new)
- Professor Lindsay Falvey (new)
- Dr Beth Woods (new)
- Mr Tony York (new)
- Ms Su McCluskey (appointed for second term)
- Dr Sasha Courville (appointed for second term)
- ACIAR CEO Professor Andrew Campbell (currently serving)

Future issues of *Partners* will profile the new Commissioners.



A poultry farmer in Kenya supplements the diets of her chickens with live whole black soldier fly larvae as part of CultiAF-2. Photo: INSFEED.

Cultivating Africa's Future Fund: innovation through partnership

High risk, highly innovative projects that could deliver breakthrough results to improve food security, resilience and gender equality are the focus of a joint partnership between ACIAR and Canada's International Development Research Centre (IDRC), to support farmers across eastern and southern Africa.

More than 70% of the rural population in this region rely on agriculture for their livelihoods, but poor performance in the sector and multiple threats, such as drought, limit their ability to consistently produce enough nutritious food to feed themselves and their communities every year. The threats are not all new, but new ways to address them are needed that have a greater impact and longer-lasting results for smallholder agricultural producers.

In response to these challenges, the ten-year, A\$37 million Cultivate Africa's Future Fund (CultiAF) was established in 2013 to leverage the strengths and resources of both ACIAR and IDRC to improve food security in the region. Now in its second phase, CultiAF-2 will boost efforts by the two development research agencies to use innovative science to build resilience to major food systems risks in the region, including drought.



Seeds sown in drought

Drought is a killer in Africa, affecting crops, livestock and people. One of the most devastating disasters to hit the region occurred in 2011–12 when some 13 million people were forced to subsist on urgent humanitarian assistance following the drought-induced Horn of Africa food crisis. A year later, CultiAF was created.

Dr Renaud De Plaen, the program leader for IDRC's Agriculture and Food Security program, says the partnership with ACIAR came at a fortuitous time. Over the past 50 years, IDRC has engaged in a broad range of research, from agriculture to education, but in 2010 IDRC decided to renew its focus on agriculture and food security as one of its core pillars. In line with this shift, IDRC and the Government of Canada formed the CA\$100 million International Food Security Research Fund to improve food security in the Global South. The fund's model formed the basis on which CultiAF was soon after built.

'This was a program designed with the idea that by working together, IDRC and ACIAR would not only leverage their respected financial resources into programming in the region but would also really engage in a partnership. This would capitalise on their respective experiences [and] their networks in the region, helping to bring greater relevance, visibility and uptake of the research,' says Dr De Plaen.

At first glance, CultiAF might not seem like the most obvious endeavour for ACIAR and IDRC to embark on. After all, Australia and Canada are not big players in the African development landscape, which is dominated by government support from European countries and the USA. But what makes IDRC and

ACIAR stand out is their shared focus on research for development. In fact, ACIAR was modelled after IDRC and a lot of Australian science is incredibly relevant in Africa because of the shared similarities with Australia such as climatic zones, says Chief Executive Officer of ACIAR Professor Andrew Campbell. 'Expertise in dryland systems, managing climate variability and designing irrigation systems for dry areas: they're all relevant to both Africa and Australia,' he adds.

The ACIAR-IDRC partnership is not only strategic, it's also efficient. IDRC has more staff in Africa so leads operational management on the ground in consultation with ACIAR. This symbiotic relationship is working out so well that it has the potential to shape the way IDRC and ACIAR work in other regions. 'We're looking at further investments in South-East Asia where we do it the other way around—where ACIAR would manage the projects on behalf of IDRC,' says Professor Campbell. 'This is a very welcome development that two donors have sufficient trust to have the other manage their funds. This allows us to work together instead of having two layers, two separate lots of administration and all the duplication that involves.'

Part of what has enabled such a natural working relationship between IDRC and ACIAR is that the two donor agencies 'completely align' on key priorities, such as gender and climate change. 'It's very easy to co-invest when you have the same priorities,' says Professor Campbell.

Investing locally

Within the African context, CultiAF's approach differs from that of many other portfolios because its projects are led by a local partner and not by an international agency. 'That means we're not just putting more money into the same international centres, we're actually building local capability in local universities, national departments of agriculture and research institutes,' says Professor Campbell. 'If the international agencies want to contribute or be part of CultiAF projects, they have to collaborate with national partners. That has been very welcomed in Africa and it's given some local researchers access to resources that they felt they didn't have before.'

During its first phase, the program operated in five countries—Kenya, Malawi, Uganda, Zambia and Zimbabwe—implementing a total of eight projects. Collectively they focused on helping smallholder farmers reduce post-harvest losses; improve crop and livestock productivity through better water use; and improve nutrition. Dr De Plaen says they have seen 'really interesting results' generated through innovative business and industry development

Key points

- 1 CultiAF is a 10-year A\$37 million partnership between ACIAR and Canada's International Development Research Centre.
- 2 By investing in high-risk but highly innovative projects CultiAF aims to improve food and nutrition security, resilience, and gender equality across eastern and southern Africa.
- 3 CultiAF projects are led and delivered by local partners and targeted at improving outcomes for smallholder agricultural producers.



CultiAF has introduced solar tent dryers in Malawi to process fish, reducing fish losses and increasing incomes. Photo: INSFEED.

solutions that have delivered improved food security, more jobs and higher incomes.

In Malawi, introducing improved solar tent dryers to process fish resulted in an almost 70% reduction in fish losses, which translated to higher incomes for the processors and more fish for consumers. Meanwhile in Kenya, where fish and poultry feed are one of the key bottlenecks to increased protein production, using insects as a sustainable animal feed has reduced production costs. Rearing the insects also has the potential to create more than 40,000 jobs in Kenya alone. These jobs could be filled by unskilled workers and people without money to invest, which opens up opportunities for more women and young people to be employed who have may have had limited access to education and financial resources.

Expanding scope and impact

Building on these results, the second phase—known as CultiAF-2—has expanded to include Ethiopia and Mozambique resulting in a total of seven countries with nine projects. The ten-year program—spanning CultiAF and CultiAF-2—is due to conclude in 2023.

‘We’re really looking at strategic collaboration to bring more impact to each organisation’s respective work in eastern and southern Africa,’ says Dr De Plaen. This phase will focus on four key priorities: 1) improving productivity and incomes and reducing post-harvest losses; 2) advancing gender equality;

3) linking agriculture, nutrition and human health; and 4) managing climate change and water sustainability.

CultiAF-2’s priorities align with various individual country and regional policies, such as the African Union’s Comprehensive Africa Agriculture Developmental Programme. That’s because both programs aim to reduce post-harvest losses, increase agricultural output and create jobs for women and youth. Also, CultiAF-2’s mandate to focus on secondary ‘neglected’ crops in regions where millions of vulnerable people are food insecure complements major local initiatives, such as the Alliance for a Green Revolution in Africa and the Forum for Agriculture Research in Africa.

‘We try to engage multiple actors, including policy-makers and private-sector groups so that the innovations being developed can hopefully be scaled up by them throughout the continent,’ says Dr De Plaen.

This innovative approach to partnering, coupled with CultiAF’s investment in higher-risk but more innovative ideas, is its key to success. Both agencies expect the approach will continue delivering results for smallholder farmers and sow the seeds for ongoing innovation through building local research and development capacity. 🌱

MORE INFORMATION:

www.idrc.ca/en/initiative/cultivate-africas-future



Case study: A flying success

As part of a CultiAF project, innovative Kenyans are turning insects into business.

Fishmeal and soybean are commonly used by Kenyan farmers as essential protein sources for their livestock and fish. But both can be too expensive for small-scale farmers to afford.

By farming the black soldier fly (BSF), the entrepreneurs have found a cheaper and more reliable and sustainable way of producing the much-needed protein.

BSF as fresh livestock feed

Kenyan farmer Roseanne Mwangi first learnt how to derive chicken feed from the larvae of houseflies fed on pig manure while attending a conference in Uganda.



Ms Talash Huijbers has developed a business that is producing, drying and packaging black soldier fly larvae for use as livestock feed.

Photo: Emmie Wachira, ACIAR

Key points

- 1 CultiAF is investing in highly innovative work to explore the development of insect farming.
- 2 Black soldier flies are proving a profitable business venture for farmers in Kenya.

Ms Mwangi's research then led her to BSF, which is neither a pest nor a vector for human disease transmission.

With support from the CultiAF INSFEED (Insect feed for poultry and fish production in sub Saharan Africa) project led by the International Centre of Insect Physiology and Ecology (ICIPE), Ms Mwangi started producing BSF in 2019. She now produces an average of 500 kg of live BSF larvae every week, which is fed directly to her chickens and pigs.

'Within two months, our free range chickens weigh 800 grams and appear huge compared to kienveji chickens in the market,' says Ms Mwangi.

'When feeding the pigs with BSF, we have noticed that the pigs get to marketable size four to six weeks earlier, which in turn reduces the feeding and labour costs involved in pig production in my facility. We have also noted the significant reduction in fat, resulting in more lean meat production from the pigs.'

Dried and packaged BSF

Commercial production of BSF is also under way with 24-year-old Ms Talash Huijbers. On her InsectiPro farm in Kenya she is on a quest to source more sustainable protein feed solutions through insects.

Ms Huijbers started experimenting with crickets, which she now produces commercially for human food. In 2018 she looked to expand, with starter BSF stock supplied via ICIPE through the CultiAF INSFEED project.

'Currently, we are at three tonnes daily production and eyeing to supply the larvae to large-scale feed enterprises in the region,' says Ms Huijbers.

Ms Huijbers dries at least 70% of the larvae she produces, packaging it for sale as livestock feed. The remaining 30% is raised to become adult flies for continuity of the colony.

Both farmers demonstrate how research can be applied when in the hands of innovative business-minded people. 🌱

ACIAR PROJECT: Insect feed for poultry, fish and pig production in Sub-Saharan Africa (INSFEED2), GP/2019/171.



Connecting the dots improves digital farm services

New smartphone apps and other digital products are overcoming distance barriers and transforming agricultural extension work around the world. But their success depends on developers taking time to understand end-users' technology preferences and information needs.

Digital product developers designing new services for farmers in low- and middle-income countries can learn many lessons from past failures, says agricultural researcher and alumnus of the ACIAR Graduate Development Program, Sam Coggins.

The first is the need to gear digital innovations to available technology, no matter how low-tech. While more farmers in South Asia and South-East Asia are getting smartphones, in African countries smartphone penetration is much lower. Farming communities there still largely communicate and access their information via voice and SMS on older mobile phones, rather than smartphone apps.

'Interfaces like older mobile phones are used at a much bigger scale in smallholder agriculture,' says Mr Coggins.

'Even for farmers who can access them, new apps require users to put a lot of trust in something from an unknown organisation. They also need a fair bit of patience and digital literacy to download and use them, not to mention reliable and cheap internet access.'

Lessons from Myanmar

In Myanmar, Mr Coggins helped develop a smartphone app aimed at helping rice-farmers improve crop yields. The app was designed to diagnose nitrogen deficiency from photos of yellowing plant leaves, allowing the user to calculate the amount of fertiliser needed to rectify the deficiency.

To the team's surprise, the farmers rejected the app, saying their most valuable possession—their smartphone—would never be taken into a rice-paddy where it could accidentally slip into the water. In fact, it turned out most of the farmers already knew about the nitrogen deficiency—the real problem was that they couldn't afford to buy more fertiliser.

The team went back to the drawing board, replacing its 'whizzbang' app with videos and infographics on

Facebook—a social-media platform farmers already used and trusted.

The focus this time is on demonstrating how to optimise crop productivity with whatever limited fertiliser farmers have by applying it at specific times in the crop cycle.

According to Mr Coggins, the experience was an important lesson about developing digital farming tools with farmers, not just for them. He has also discovered that agri-apps are used not just by farmers but by others in their networks (such as input retailers and extension workers) to overcome distance barriers and make themselves more informed.

Developing solutions that last

Mr Coggins worked with another team that interviewed 40 developers and users of digital extension products to find out which tools had worked and why. The interviews—funded by ACIAR and the Bill & Melinda Gates Foundation—included participants from Africa, South Asia and South-East Asia.

The findings confirmed the need for developers to build on existing digital platforms that were already used at scale: for example, WhatsApp, farmers' Facebook profiles, YouTube channels and agri-apps with large established user-communities.

Key points

- 1 Digital agriculture is helping smallholder farmers access information, finance and services.
- 2 Participatory development with farmers is key to developing relevant, useful and long-lasting digital solutions.



User testing of crop fertiliser apps in Myanmar by a government extension worker. She also communicates with farmers and colleagues via Facebook Messenger. Photo: Sam Coggins.



A rice farmer from Bago, Myanmar, uses his smartphone to measure fields using satellite imagery; access agri-apps for weather, prices and agronomy information; and network with other rice farmers via Facebook. Photo: Sam Coggins.

Success stories

Mr Coggins says he's come across plenty of examples of digital farming services that work.

For example, Plantix is a free smartphone app that allows farmers to access diagnostic and treatment advice for diseased and insect-infested plants by uploading photos. According to the website, the app covers 30 major crops, detects 400 plant problems, is available in 18 languages and has had more than 10 million downloads. Mr Coggins says the information is high quality because the app is run by a machine-learning algorithm that constantly improves as it 'learns' from the data it is fed.

Another example is Farming Leader: a YouTube channel with millions of subscribers across India. It is run by Darshan Singh, a Punjabi farmer who showcases videos on everything from artificial insemination of livestock to the latest tractors.

On the financial side of agribusiness, M-Pesa is an example of a mobile phone-based money transfer, payment and micro-financing service. It is used by farmers (among others) in African countries to deposit, withdraw and transfer money and to pay for goods and services via PIN-secured SMS text messages.

It is important to develop digital farming tools with farmers, not just for them.

Sam Coggins

Two-way digital extension

For Mr Coggins, the future of digital farm services is about 'getting the reverse arrow going in digital extension'.

'Instead of digital tools where "experts" tell farmers what they ought to do, we need to have tools through which farmers can tell experts, venture capitalists and donors what they ought to do. We can tap into farmers' strengths and knowledge acquired from hands-on experience and insights into local conditions,' he says.

'That's really exciting. Everyone complains that participatory development is time-consuming and expensive, going out to farms and sitting down with farmers to work together. Of course face-to-face is still crucial. But we can complement that with working together remotely and digitally.'

'The other thing we discovered is the need to plan for sustainability,' says Mr Coggins. 'A lot of these digital extension services die when project funding runs out. This is another argument for using existing platforms or apps that already have a sustainable business model behind them.'

Currently, Mr Coggins is working in a team based at Cornell University in the USA on a review of digital farmer services in low- and middle-income countries.

'We're reviewing all the evidence out there about digital farming services to find which services have been used, which ones haven't, and why, and what outcomes they lead to, whether that's positive or negative.

'This work is about trying to help those who create digital farming services to make more informed decisions about where they invest. The main audience is agriculture-for-development donors like ACIAR, the Bill & Melinda Gates Foundation and USAID.'



Younus Ali of Durgapur, Rajshahi, Bangladesh, operates his versatile multi-crop planter, a zero-till planting machine designed for small farms and a range of crops. Photo: Emanuel Haque.

‘Micro’ mechanisation rolled out

It may be small but the VMP (versatile multi-crop planter)—a zero-till planter that can be adapted for different crops—is improving soils and reducing fuel, labour, seed and fertiliser costs for a group of early-adopter farmers in Bangladesh.

The planter, designed for use with a two-wheeled tractor, is being commercially made and marketed within Bangladesh with support from funding delivered through the Australian Department of Foreign Affairs and Trade’s (DFAT) Sustainable Development Investment Portfolio (SDIP) with ACIAR.

SDIP and conservation agriculture

DFAT established SDIP to help improve the management of water and energy for food production in South Asia, with a particular emphasis on empowering women. ACIAR SDIP focused on the Eastern Gangetic Plains in the area where India, Nepal and Bangladesh meet.

Farmers in these countries face many challenges, including farm-labour shortages as more people move to cities; more frequent floods and drought due to climate change; and land degradation from decades of heavy tillage and crop intensification.

Through SDIP-funded partnerships, farmers, researchers, extension staff and government officers have been introduced to conservation agriculture: an innovative, more sustainable approach to farming that has been practised in developed countries for decades.

Conservation agriculture is based on practices like zero-till planting to protect soil structure and integrity; crop-residue retention to preserve soil carbon and moisture; and crop rotation to protect soil fertility and health.



‘Non-puddling’ technology

While Australia, Brazil, the USA and other broadacre cropping countries have developed huge zero-till conservation agriculture machines for use over large areas, countries like Bangladesh—where the average family farm is 0.3 hectares—require smaller solutions.

The pioneering VMP was initially developed through an earlier ACIAR project to open up a market for small-scale conservation agriculture mechanisation. It is now being more widely promoted through a SDIP-funded research-and-private-sector partnership.

The partnership includes a Bangladesh equipment manufacturer and a bank, as well as extension staff and local service providers—entrepreneurs who purchase agricultural equipment so they can contract their services to farmers in their area.

Murdoch University’s Dr Enamul Haque, who is based in Bangladesh, is a member of the VMP development team. As he explains, intensive rice-based cropping accounts for 80% of Bangladesh’s total crop area, with farms growing two or three rice varieties and several non-rice crops—such as wheat, maize, lentils, chickpea and mustard—annually.

‘Farmers generally do two to six tills of the soil and “puddling” before they transplant rice seedlings,’ says Dr Haque. Puddling is the traditional practice of heavily tilling soil in flooded rice paddies. Over many years, this leads to the development of a hardened layer of soil known as a plough pan.

The use of the VMP opens the door to non-puddling technology. After the soil is flooded, the machine makes a narrow slit in the soil into

which the seedlings are transplanted. The VMP can also be used to sow rice seeds directly, as in dryland cropping.

‘Our long-term trials have shown that this new way of conservation agriculture in rice-based systems reduces labour, fuel and other costs without losing yield.’

The ‘multi-crop’ features enable farmers to plant a range of crops, as the VMP can accommodate variable seed sizes and row spacing. Importantly, row-spacing adjustment can be done by the operator in the field using only a spanner.

The VMP also applies fertiliser with the seed. Its effectiveness as a ‘single pass’ planter can bring about a 50–85% saving on fuel costs.

Challenges to scale-up

Local farm-equipment manufacturer Mr Mizanul Hoque has been making the VMP commercially since 2016, partnering with the ACIAR researchers to promote it to farmers, local service providers, extension workers, financiers and government officials through demonstrations, field days, after-sales service and training, and incentives.

As of October 2020, Mr Hoque had sold 211 units. He aims to manufacture and sell more units to more local service providers.

One of those local service providers is Mr Khorshed Alam, from Bangladesh’s Panchagarh district, who purchased a VMP in 2018. He rents it out to other farmers and uses it on his own farm, where it has reduced labour, fuel and seed costs and increased crop yield and profit. He says the additional rental income has helped improve his livelihood.

For Mr Hoque, making the VMP more cost-competitive for Bangladesh farmers is complicated by the fact government subsidies are largely directed to full-tillage rice mechanisation.

Dr Richard Bell, also with Murdoch University, points out that in Australia and the USA the introduction of conservation agriculture was pushed along by government incentives to control erosion. Without government intervention, promotion of the VMP across Bangladesh relies almost solely on Hoque Corporation’s efforts.

‘Hoque Corporation saw the opportunity and has worked hard to develop the market,’ says Dr Bell. ‘We want to try to make the VMP successful to open the market so that more farmers take conservation agriculture on board.’

Key points

- 1 Bangladesh’s Hoque Corporation is manufacturing the versatile multi-crop planter, which was developed as part of an ACIAR project.
- 2 The planter supports conservation agriculture and helps farmers manage their soil better, and it saves them fuel, seed and fertiliser costs.
- 3 Innovative partnering with a local machinery manufacturer who is developing the market is helping the planter to reach more farmers.



‘What we’re doing with the VMP is part of a bigger wave of mechanisation for smallholder farmers in South Asia. So, understanding how to commercialise machinery and how to mechanise smallholder farmers is a critical and urgent question.’

Conservation agriculture in West Bengal

ACIAR-SDIP Program Manager, Dr Tamara Jackson, is part of a team that has been encouraging the adoption of conservation agriculture throughout the Indian state of West Bengal since 2012.

Through a network of stakeholders—from farming communities, an agricultural university, international research organisations, the state agriculture department and local service providers—conservation agriculture is now practised by more than 70,000 farmers.

Dr Jackson attributes this success to a number of factors, including strengthened links between UBKV (a local agricultural university), and the state extension offices; more than 200 on-farm trials; a growing network of ‘champions’ among farmer groups and local service providers; and technical support from international research organisations—in particular, the International Maize and Wheat Improvement Center.

Crucially, the demonstrations and grassroots advocacy have attracted high-level support for conservation agriculture from the West Bengal Government. It is now compulsory for new equipment hire centres to

include at least one conservation agriculture machine in their portfolio, and local extension staff are able to allocate government resources to the promotion of conservation agriculture.


‘The West Bengal Government is also now establishing a Center of Excellence for Conservation Agriculture at a university in northern West Bengal,’ says Dr Jackson.

‘It takes years to get to this kind of huge change in what farmers have been doing for generations. It’s a risky thing to change your farming systems.’

Dr Jackson says the SDIP research shows conservation agriculture and mechanisation can benefit women, reducing the time spent on manual farm labour and presenting new farm income opportunities.

‘For example, in West Bengal, with mechanical rice transplanters you need to grow rice seedlings beforehand. Women are doing that in groups—they’re producing and selling those rice seedlings and making quite good money from it.

‘You get about a 30% labour reduction with conservation agriculture so women talk often about the fact they’ve saved time and they can use that to do additional income-generating activities, spend more time with their family or do all the other chores they have to do.

‘The success of this initiative is really due to the hard work of our local partners at UBKV, the farmer organisations and the state Department of Agriculture. It is their passion that has made the shift to conservation agriculture happen in West Bengal.’ 



Members of the Mukta Self Help Group in West Bengal deliver an order of rice seedlings to rice-transplanter owner, Mr Askar Ali. Through the SDIP program, the group learned how to produce rice seedlings to sell to rice transplanter machine operators. Earnings group members make as a result are improving their livelihoods. Photo: Conor Ashleigh, ACIAR.

ACIAR PROJECTS:

- Sustainable Development Investment Portfolio (aciarsdip.com)
- Commercialisation of smallholders’ CA-based planters in Bangladesh, LWR/2018/111
- Value chain and policy interventions to accelerate adoption of Happy Seeder zero tillage in rice-wheat farming systems across the Gangetic Plains, CSE/2017/101



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