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IN RESEARCH FOR DEVELOPMENT



NUTRITIONAL SECURITY

● FOOD DIVERSITY ● HEALTHY FARMS ● FOOD SAFETY

HEALTHY PEOPLE, BETTER OPPORTUNITIES

Good nutrition forms the foundation for healthy bodies, healthy minds and healthy lives. ACIAR is giving attention to research aimed at improving the nutritional security of vulnerable communities. This issue of *Partners* takes a closer look at the issue of nutrition in agricultural research for development.

The Australian Government's new aid program promotes sustainable economic growth and poverty reduction through a multifaceted approach, including targeting health, education and gender equality. Improving nutrition is high on the agenda, recognising that good health is an essential factor in enabling poor people to take up opportunities to become educated and earn a living, breaking the poverty cycle.

Lack of access to a range of healthy foods is a key contributor to poor nutrition in many countries. ACIAR has committed to research delivering access to diversified and nutritional diets in its new *ACIAR Strategic Plan 2014–18*.

In this issue we showcase ACIAR research around the world linked to improving nutrition through a variety of approaches—from crop diversification to livestock disease management and from market engagement to food safety. Much of the research targets women as the natural champions for their families' health and wellbeing.

The Australian Government's new aid program promotes sustainable economic growth and poverty reduction through a multifaceted approach, including targeting health, education and gender equality.

In Vietnam, ACIAR research is not only opening market opportunities for poor smallholder vegetable farmers, but also providing broader access for consumers to fresh produce (page 6). In the Pacific, a return to nutritious traditional foods is being promoted to help diversify diets and alleviate deficiencies (page 8).

In southern and eastern Africa, ACIAR's nutrition research focus is on opportunities for growing vegetables in peri-urban areas and on integrating village poultry and crop production in rural areas (page 10).

The importance of small bony fish as an essential source of nutrition for people in the Pacific and South-East Asia is highlighted on page 14, including snapshots of our small-fish research in Burma, Cambodia, Lao PDR and Papua New Guinea. Pork is an all-important food in Vietnam and Lao PDR—page 18 describes work in these countries that is helping to ensure pork is produced in a safe way for consumers.

Efforts to diversify crop production in Burma with protein-rich legumes that will potentially improve diets are described on page 16.

The concept of good nutrition extends to what we feed our animals, our crops and our soils. Some case studies of research addressing nutrient deficiencies in livestock and soils are given on pages 12 and 13.

Further articles cover social research on impacts and opportunities from natural resource pressures in Lao PDR and research guiding forestry practices in Lao PDR, including allowing room for growing crops among trees.

In the opinion article on page 24, Associate Professor Ruth Colagiuri and Dr Si Win Tin discuss the need for carefully planned, multidisciplinary research to avert the dangers of growing prosperity going hand-in-hand with overnutrition associated with obesity, diabetes and cardiac disease.

Finally, our News section gives an overview of what has been happening around ACIAR in the past few months including special events, staff changes and our latest publications. ■



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IN RESEARCH FOR DEVELOPMENT

Partners in Research for Development is the flagship publication of the Australian Centre for International Agricultural Research (ACIAR). *Partners* presents articles that summarise results from ACIAR-sponsored research projects and puts ACIAR research initiatives into perspective. Technical enquiries will be passed on to the appropriate researchers for reply. Reprinting of articles, either whole or in part, is welcomed, provided that the source is acknowledged.

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FOCUS ON NUTRITIONAL SECURITY

Measured as calories consumed, the world has made progress towards reducing hunger, cutting the incidence by a third in the past decade, according to figures from the United Nations' Food and Agriculture Organization (FAO). However, about 870 million people are facing severe food deprivation on a daily basis.

That the world produces enough food to eradicate hunger is not in doubt. But as wealthy nations face an unprecedented food crisis of their own—in the form of an obesity epidemic that elevates the risk of developing diabetes, heart disease and some cancers—the world has had to reconsider how it reckons the consumption of food and what constitutes a healthy diet.

What has emerged is the idea of 'nutritional security'. This idea recognises that in addition to sufficient calories, a range of nutrients in the right proportion is needed to maintain health, with the optimum proportion varying during a lifetime and in different circumstances.

Framed this way, it is not just nutrient scarcity in the form of undernutrition in the developing world that can cause health, social and economic problems for people. Overnutrition, in which nutrients are not scarce but consumed in inappropriate amounts or proportions, has joined undernutrition as a pervasive global problem affecting millions of people's health and quality of life.

As such, variation in the nutritional value of different foods is raised in importance and with that comes the need to re-evaluate the world's food production, processing and marketing systems. ■

What is nutritional security?

Nutritional security goes beyond advocating for appropriate quantities of food. It also addresses people's need for an appropriate combination of nutrients from their diet—combinations that are required to sustain growth, health, healing and an active life for all people at all stages of development. Health problems—and associated social and economic effects—can arise from both deficient and excessive consumption of micronutrients and macronutrients.

THE MACRONUTRIENTS

Macronutrients are the building blocks for growth, needed in large proportions to provide energy and to maintain and repair the body. They are:

- carbohydrates
- proteins
- fats
- water
- minerals such as salt, calcium, magnesium and potassium.

THE MICRONUTRIENTS

Micronutrients are the vitamins and minerals needed in small-to-minute amounts. Micronutrient deficiencies are common and have long-ranging effects on health, learning ability and productivity, leading to high social and public costs, reduced work capacity in populations due to high rates of illness or disability and tragic loss of human potential. The three most prevalent micronutrient deficiencies in developing countries are:

- iron deficiency—resulting in anaemia
- iodine deficiency—resulting in brain damage and mental retardation
- vitamin A deficiency—resulting in blindness.

Effects on children

STUNTING: low height for age due to inadequate nutrition over a long period.

- 195 million children under five years of age
- 90% live in Asia and Africa

UNDERWEIGHT: low weight for age indicating either acute or chronic malnutrition.

- 129 million children under five years of age
- 27% live in Asia and 21% in Africa

WASTING: low weight for height usually due to a recent nutritional deficiency.

- 26 million children under five years of age
- 5% are severely wasted

OBESITY: excess body fat in relation to lean body mass.

- The proportion of children who are overweight or obese has increased by about 60% in the 20 years to 2010, according to the World Health Organization. The problem affects about a quarter of all children in Australia and more than a third in the USA, but with the trend now also evident in developing countries.

- Health effects include risk factors for cardiovascular disease, high blood pressure and glucose levels (pre-diabetes), bone and joint problems, and sleep apnoea.

"Poor and vulnerable populations need more resilience, and a vital part of building resilience involves boosting food and nutrition security."

— The 2013 Global Hunger Index report



Undernourishment

The outcomes of nutritional insecurity are of growing concern globally due to the constraints they impose on human health and on the socioeconomic development of affected communities.

Figure 1 Undernourishment in the developing regions

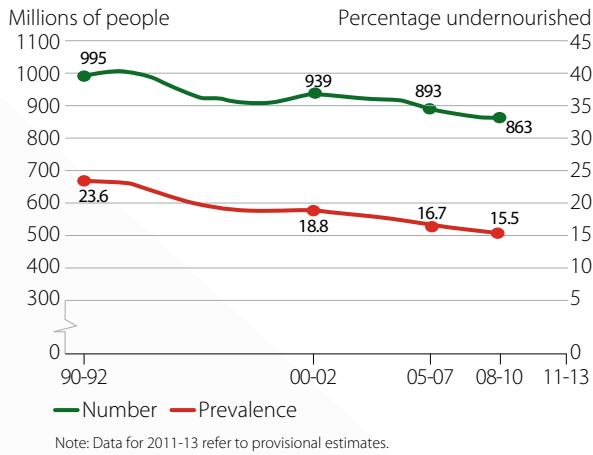
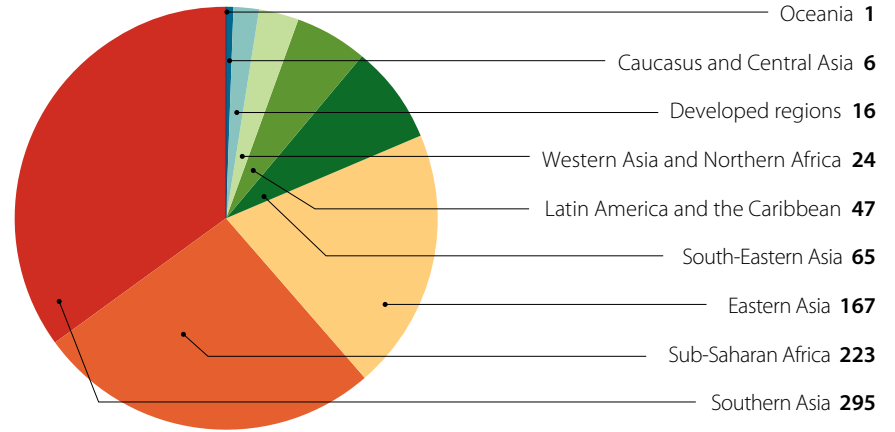


Figure 2 Undernourishment in 2011-13, by region (Millions of people) **Total = 844 million**



Note: All figures are rounded.

Source: FAO

PHOTO: WWW.123RF.COM



A child eats with his father during a break from working on the farm in Bali, Indonesia.

A role for ACIAR

ACIAR recognises the importance of diet diversity in human nutrition, including due consideration for vitamin and mineral deficiencies and key indicators such as stunting.

There are strong linkages between nutrition and increased productivity, dietary diversity,

urban and rural farming systems, food safety and a value-chain approach. Increasing awareness and creating advocacy on appropriate food choices at family to institution levels is also important, including choices about indigenous crops, animal protein and non-farm food supplies.

Key activities related to nutrition undertaken by ACIAR include integrated multidisciplinary research, nutrition education, consumer-led community approaches, use of appropriate plant and animal species in agricultural diversification, and approaches that lead to evidence-based policy.

Women working wonders in Vietnam

Poor smallholder farmers in north-west Vietnam are proving they can produce and sell commercial quantities of safe, nutritionally rich vegetables given a little research and development support

Australia's Minister for Foreign Affairs, The Hon. Julie Bishop MP (right), visits a display of vegetables with Vietnam Women's Union President Hoa (to left of Minister Bishop) in Hanoi, at the launch of an ACIAR vegetable project.



BY DR GIO BRAIDOTTI

Since the 1980s, Vietnam has used a food-based strategy in their fight against undernutrition that encourages villagers to participate in all three components of food production—plants, ponds and livestock—and to improve the quality and not just the quantity of food.

This policy has led to annual growth in food production and to changes in the structure of the Vietnamese diet so that it now includes fewer starchy cereals and a higher proportion of meat and fish.

Some sectors of the population, however, receive less than the required intake of certain micronutrients. "Deficiencies in iron, minerals and vitamins caused by eating mostly cereals impacts the health of about half the country's population," Dr Le Danh Tuyen, deputy director at the National Institute of Nutrition, told *Viet Nam News*.

"Addressing micronutrient deficiency is still vital to solve health problems in Vietnam and it is an important component of the 2010–20 National Strategy for Malnutrition Prevention."

A ROLE FOR SMALLHOLDERS

Vietnam's decision to co-opt agriculture in the fight against malnutrition—and to do so in ways that reduce poverty—offered opportunities for ACIAR to engage with Vietnam to better exploit the nutritional value of vegetables.

The work was undertaken with Vietnam's ethnic minorities in the mountainous north-west provinces of Lao Cai and Phu Tho. The overall goal was to raise the production, consumption and commercialisation of the region's nutritionally rich indigenous vegetables.



PHOTO: SUZIE NEWMAN

The project ran between 2008 and 2012 and was led by Dr Suzie Newman from the University of Adelaide (previously with the New South Wales Department of Primary Industries). Essential to the project's success was the strong partnership with the Vietnam Women's Union.

"The original project focused on indigenous vegetables but in Vietnam that covers a lot of different plants," Dr Newman says. "So initially we selected six 'model' vegetables that included plants harvested for their leafy material, roots and fruit as well as annual and perennial plants."

In Lao Cai province the vegetables selected were Cai meo (a bitter, leafy brassica), Bap cai xoe (an unfolded cabbage) and Khoi tu (a perennial with a high-value leafy crop).

In Phu Tho province the vegetables selected were Bo khai (a leafy vegetable that appeals to urban gourmets and is no longer readily available from forests), Khoai tang (an indigenous taro) and Muop dang (a small, bitter melon—featured on this issue's cover).

"Some of these indigenous vegetables can be nutritionally better for you than some of the more 'everyday' vegetables," Dr Newman says, referring to analyses undertaken in Vietnam by project partner, the National Institute of Medicinal Materials.

Included in the research are micronutrients especially targeted by Dr Tuyen and the 2010–20 National Strategy for Malnutrition Prevention. Khoi tu and Khoai tang, for example, were found to contain extremely high levels of iron (iron deficiency is one of the three most common micronutrient deficiencies in the world). Cai meo and Muop dang are especially rich in vitamin C.

"Different vegetables have different nutrient profiles and deliver different nutritional benefits," Dr Newman says. "Some profiles were more towards the standard range but there were definitely others that pack extra nutritional benefits."

In 2008, the communities that grew these indigenous vegetables possessed few market links. As a result, consumers were missing out on the vegetables' health benefits and smallholder farmers lost out on new income opportunities.

By building an interdisciplinary team that included seven Vietnamese institutions, a way was found to take these vegetables from small-scale production in the remote north to semi-commercial and commercial levels of production capable of supplying markets across Vietnam.

Along the way, smallholder farmers were helped to overcome production constraints,



Vietnamese smallholder farmer preparing to sell bitter melon at market.

address postharvest storage and transport challenges, and develop marketing strategies and supply chains to local, regional, urban and (now, with a new project) international markets.

Farming innovations were identified by working with groups of about 30 farmers in six communes, with the groups composed mainly of women. A broad range of production issues were addressed, including soil nutrient management, suitable trellis structures, harvesting, storage and intercropping with, for example, plum trees.

Research activities also addressed concerns raised during consultations with representatives from across the supply chain, including collectors, wholesalers and retailers.

The findings were then collated into training material and teaching resources that are being made available to smallholder communities more broadly, including through a popular farmer learning tool—the farmer business school.

“While some of this research was in response to issues the farmers themselves raised, we were also working to understand how to move crop production to a more commercial scale,” Dr Newman says. “So marketing was also a strong focus of the project.”

CLEAN, GREEN AND SAFE

Experience across ACIAR programs has clearly established that with the provision of some R&D support, smallholders can develop their production systems into small, dynamic agribusinesses.

Running in favour of the north-western vegetable producers is the perception within Vietnam’s urban consumers that their produce is clean, green, safe and healthy. As a result, retailers in large cities, including Hanoi, are prepared to work with farmers to get the vegetables to market.



(Left) Indigenous taro is one of six vegetables targeted in an ACIAR project to help improve smallholder income and national health.

(Below) Training in bitter melon planting techniques in north-western Vietnam included trellis construction.

“We know that indigenous vegetables have a niche market opportunity in that they fetch a much higher price than your everyday ‘global’ vegetables,” Dr Newman says. “So there is a real opportunity for the smallholders to earn extra income.”

Concurrently, as word spreads to diversify diets with meat and vegetables, opportunities increase for farmers to incorporate nutritionally rich and high-valued vegetables into existing rice and horticultural systems.

“Many farming systems are in transition in Vietnam,” Dr Newman says. “With the fruit system, for instance, there are opportunities to grow vegetables as an intercrop but we want to ensure this does not detract from a well-established and lucrative production system, such as plums.”

Another issue the team wants to explore is whether increased production of vegetables is leading to increased consumption of vegetables and improved health benefits.

“There are still some malnutrition issues in these areas, particularly with children and stunting,” Dr Newman says. “So we want to look more broadly and try to understand whether there is a health benefit beside an economic one to commercialising vegetable production.

“To do that we are taking more of a systems



Chefs in Sa Pa, north-western Vietnam, prepare dishes using indigenous vegetables for public taste testing as part of a marketing exercise undertaken within an ACIAR project. Recipes were subsequently made available on recipes cards provided with vegetables sold at markets across Vietnam.



approach, including the whole farming system. That lets us better understand how these different production systems impact household income and health.” ■

ACIAR projects: AGB/2006/112, AGB/2012/059
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Vibrant colours, vibrant lives

ACIAR is promoting the production and consumption of traditional, colourful fruit and vegetables in the Pacific region to diversify diets, alleviate vitamin deficiencies and revitalise pride in local culture



BY DR GIO BRAIDOTTI
AND DR WENDY HENDERSON

Along with several cultural changes largely associated with urbanisation, Pacific Islanders and Indigenous Australians have followed a pattern of increasing consumption of high-energy, low-nutrient foods, drifting away from traditional diets.

As a result, public health issues have grown at an alarming rate. Growing and eating traditional foods high in vitamins and minerals has recently been identified as a priority by governments in the Pacific, to reverse these trends and improve their people's nutritional security.

Vitamin A deficiency has been an especially important issue to target, with deficiencies notable in infants, children and pregnant or nursing women. This vitamin is essential for a well-functioning immune system. It also reduces the spread of malaria, prevents night blindness, and protects against anaemia, diabetes, heart disease and certain cancers.

ACIAR has been investigating opportunities and challenges in indigenous fruit and vegetable production and consumption in the Pacific since 2006.

Led by Dr Graham Lyons of the University of Adelaide, a project in Solomon Islands helped local communities to grow, market and consume more of the colourful vegetables and fruits—orange-fleshed sweetpotato, pawpaw and yellow 'toraka' bananas—that are rich in the carotenoid compounds needed by the body to make vitamin A.

"As little as 100 grams a day of orange sweetpotato is able to prevent vitamin A deficiency," Dr Lyons says.

When he started the project, he found that Solomon Island villagers grew a small amount of orange-fleshed sweetpotato because

PHOTO: SARAH VANDERMARK



Kiteni Kurika, of Papua New Guinea, steaming indigenous aibika leaves with coconut milk.

they liked the colour and children especially liked the flavour, but had no idea it delivered important health benefits.

“The ACIAR work examined how these and other micronutrient-dense foods could fit into the traditional food system while also making seed and cuttings available to farmers,” Dr Lyons says. “Social and cultural factors relating to production, marketing, consumption and acceptability were also explored.”

About 77 orange and yellow sweetpotato varieties were analysed for their nutrient

content, particularly their levels of carotenoids. Nutrient-rich cultivars were then evaluated in on-farm trials, largely by women’s farming groups. Promising varieties that were highly regarded by local producers and consumers—for their insect and disease resistance, yield and flavour—were then multiplied for further distribution.

A strong focus of this work was on raising local awareness about the nutritious value of the sweetpotatoes, as well as other nutritious local food. A series of workshops, community

plantings, street theatre and other activities promoted the growth and consumption of these foods, along with a ‘Go Local’ slogan to encourage a move away from imported foods back to traditional diets.

A special effort was made to target communities with acute nutritional and food security problems.

Riding on the momentum created by this project, Dr Lyons has conducted similar work with leafy green vegetables in Torres Strait, Solomon Islands and Samoa, Tonga and Fiji (see side article). A new larger project will be conducted in Kiribati, where the challenges are even greater.

In Papua New Guinea (PNG), ACIAR research led by Dr Tania Paul of Charles Darwin University has explored what traditional leafy vegetables are available and which ones might be acceptable for wider production, consumption and marketing. This work has targeted peri-urban producers, and women in particular, as the key people involved in home gardening and family nutrition.

Focusing on the practicalities of crop diversification and marketing, Dr Paul’s work has also involved important social elements such as teaching women appropriate cooking options to encourage consumption of the traditional foods. The aim is twofold: to increase income opportunities and to provide access to increased nutrition.

A larger project continuing this work in PNG will aim to scale out the work and develop markets for traditional vegetables in Bougainville and Port Moresby regions.

The complementary approaches taken in all these projects—of both enabling and promoting the growing and eating of traditional foods—have led to changes in local attitudes. Many villagers in Solomon Islands and PNG, for instance, are now actively growing more of these more nutritious foods, demonstrated by the increased presence of colourful vegetables and fruits at local markets. With increased availability and access to traditional foods, the pendulum should swing back to better nutrition. ■

ACIAR projects: [PC/2006/106](#), [HORT/2011/064](#), [ASEM/2010/052](#), [PC/2014/021](#)

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Elick Guaf from PNG National Agricultural Research Institute can be viewed discussing sweetpotato research activities at: www.youtube.com/watch?v=Bm99MkqjU08

Leafy vegetables recruited to battle white food

A series of fact sheets produced by Dr Graham Lyons (University of Adelaide) and colleagues spell out the recent history of indigenous communities in the Pacific region consuming high-energy, low-nutrient foods—and the value of replacing these foods with traditional leafy vegetables.

Such a diet—including white flour, white sugar, polished rice, turkey tails and mutton rib flaps—combined with reduced physical activity results in some of the highest incidences of metabolic disease in the world. These include obesity, heart diseases, diabetes and certain cancers.

Research has shown that most leafy vegetables are valuable foods, rich in compounds that can reduce the risk of developing micronutrient deficiencies and metabolic disease.

Included among the healthful compounds are proteins, minerals, vitamins (A, B, C and K), fibre, and beneficial plant chemicals with antioxidants and anti-inflammatory properties. The latter include glucosinolates (present in drumstick leaves) and anthocyanins (present in purple sweetpotato leaves).

“The project was fortunate to have access to one of the best analytical laboratories in the world for analysing a wide range of mineral nutrients and pollutants—Waite Analytical Services at the University of Adelaide,” Dr Lyons says.

Despite many different types of leafy vegetables being grown and eaten in the Pacific region, Dr Lyons attributes cultural changes since the 1940s as having relegated vegetables to a “low-status food”.

“Most leafy vegetables can be easily grown in home gardens and some crops that are grown for their tubers such as taro, sweetpotato and cassava also have nutritious, edible leaves,” Dr Lyons says. “Other leafy vegetables are found growing in the wild, sometimes as weeds or wayside plants such as black-berried nightshade and cobbler’s pegs.

“The leaves usually have higher concentrations of vitamins, minerals and other beneficial compounds than the roots, which are higher in carbohydrate and, therefore, energy.”

A variety of foods—including leafy greens—are needed to achieve optimum body and brain growth, development and general good health. As such, Dr Lyons’s fact sheets recommend the consumption of 1.5 cups (three handfuls) of leafy vegetables a day.

“Leaves reduce the glycaemic load when eaten with high-energy foods such as bread and white rice, and they are an ideal weight-loss food,” Dr Lyons says.

Beside their nutritional value, many leafy green vegetables have been used traditionally for medical applications. For example, aibika and sweetleaf are used for bone repair, Ceylon spinach serves as an anti-inflammatory and drumstick as an antibacterial agent.

Expansion of traditional food gardens can also help address the trade deficit associated with the high consumption of imported foods in the Pacific region. Food gardens also increase food crop diversity, which in turn enhances resilience in the food system and food security.

Dr Lyons says the vegetables targeted in the ACIAR project can often be eaten either raw or cooked. The optimum cooking methods include steaming, boiling in a little water, baking and stir-frying (ideally in virgin coconut oil or coconut cream) for as short a time as possible to reduce nutrient loss. Some recipes for salads and soups are included in the fact sheets.

There are 12 fact sheets produced in the leafy vegetable series, with 10 featuring the most nutritious leafy vegetables.

ACIAR project: [PC/2010/063](#)

More information: [The leafy vegetable fact sheets can be viewed at: \[www.aciar.gov.au/News2013July\]\(http://www.aciar.gov.au/News2013July\)](#)



A boy brought in his hen for Newcastle disease testing in Zambia.

PHOTO: BRIGITTE BAGNOL

Nourishing Africa's future generations

Training young producers in best growing practices and strengthening the capacity of women to produce poultry and crops are two projects that aim to boost nutrition in southern and eastern African countries

BY LINDA VERGNANI

Good nutrition in the first 1,000 days after conception is crucial for children's survival and future health, but providing expectant mothers and babies with a better diet in this critical period is not simply a matter of producing more staple crops.

"Access to calories isn't sufficient for healthy communities," says Mellissa Wood, director of ACIAR's Australian International Food Security Research Centre (AIFSRC).

"If you don't have access to good nutrition for the whole period from conception to the age of two, you are likely to have impairments all your life. It's a vicious circle—poverty leads to malnutrition, which leads to stunting and poor performance, which means less chance of

people reaching their potential as adults, which leads to unemployment and more poverty."

The solution is multifaceted and includes sound government nutrition policies, providing poor people with job opportunities and better incomes, vaccinating poultry and livestock against disease, improving food storage and safety, and finding more efficient ways of getting nutritious foods to markets.

One of the primary areas of AIFSRC's research is food systems, focusing on better nutrition policy and practice and increased food safety. The nutrition projects funded by the centre are multidisciplinary and fall in the "under-researched nexus between agriculture, nutrition and health". They are aimed not just at improving food security and nutrition, but ultimately at stimulating economic development.

Ms Wood says: "We are looking at very targeted, nutrient-sensitive agriculture as part of our emphasis on food systems research."

NUTRITION AND EMPLOYMENT

The AIFSRC is funding a vegetable project designed to reduce malnutrition in children and generate employment and income for younger producers in 120 peri-urban communities in Tanzania, Ethiopia, Malawi and Mozambique.

The project hopes to fast-track adoption of improved practices and technology, demonstrating better methods of crop, soil and water management and improving food storage and safety. This, in turn, will promote production and consumption of more nutritious and saleable vegetables, benefiting about 6,000 farming families.



It is not enough to grow more, safe and nutritionally rich vegetables. Ways have to be found to create better storage mechanisms and linkages with markets.



Ms Mellissa Wood, director of the Australian International Food Security Research Centre, takes time out to thresh grain in Tanzania while touring project sites in Africa.



Women farmers in Africa are participating in research for development projects in which improvements to their crops and poultry systems are being used to address longstanding, intergenerational nutrition deficiencies.



Where African women play a particular role in poultry and egg production systems, assistance is being provided to optimise production as a way to improve household-level nutrition, health and income.



Dr Robyn Alders is well known to smallholder poultry producers in parts of Africa where Newcastle disease is rife. She is now aiming to reach about 10,000 people across the 20 communities in a project that ties together animal, crop and human health.



Projects to address nutrition security are designed to concurrently benefit smallholder farmers and the supply chain, with solutions to marketing challenges built into the project.

FAMILY POULTRY TO STRENGTHEN FOOD SECURITY AND NUTRITION

Another major project aims to strengthen food security and nutrition through integrating and improving family poultry and crop systems in Tanzania and Zambia.

Ms Wood says: "The poultry project has a very strong gender focus. We know that when women have access to money through marketing poultry and crops, they are more likely to spend it on nutrition, education and improving the health of their families."

"We are aiming to reach about 10,000 people across 20 remote communities," says project leader Dr Robyn Alders, an associate professor in the Faculty of Veterinary Science at the University of Sydney. The research looks at food and nutrition through a "one health approach", which ties together animal, crop and human health.

"It's quite a novel project because it combines agriculture, livestock, public health initiatives and nutrition," she says. The research team includes animal and human health specialists, crop scientists, economists, anthropologists and a veterinary ecologist.

Dr Alders started her work on preventing Newcastle disease in Africa in 1989 with funding from ACIAR to develop a vaccine for poultry. She received the Order of Australia in 2011 for her contribution to food security in developing countries.

"The reason the new project focuses on women is that at the household level, they are more likely to control village chickens and also some secondary crops, including nutritious grains such as millet," Dr Alders says.

This project is addressing key nutritional issues, such as deficiencies in iron and vitamin A. As part of the nutrition analysis, researchers will measure micronutrient levels in the blood of people in the study areas before and after the program.

"We are looking at a good combination of nutrients that could improve the diet of pregnant women and children in the first 1,000 days after conception," Dr Alders says.

Based in remote areas, where poultry has not yet been vaccinated, part of the research will involve vaccinating flocks against Newcastle disease and seeing what immediate and long-term impact the survival of more birds has on the nutrition of babies and children.

The researchers will study household budgets and what foods villagers eat at different times of the year. Dr Alders says there is a range of complex issues that affect nutrition and diet.

"There are certain taboos around eggs in certain areas and that makes sense in circumstances where your birds keep dying of disease."

In villages where pregnant women cannot get proper obstetric care, they may refuse to

eat eggs because they are worried that their babies will be too large and that they will have obstructed births.

Because crop production is cyclical and affected by disease, drought and climate change, subsistence farmers often struggle to find enough to eat.

Dr Alders says once they have built up healthy flocks of chickens, women can trade eggs and chickens for livestock or sell them during the "hunger periods" and use the money to buy a greater variety of food.

One outcome of the project will be a cost-benefit analysis that can underpin policy decisions about agricultural interventions to improve nutrition and food security in Zambia and Tanzania. That analysis will be relevant to other Sub-Saharan nations. It is this sort of research backed by policy development that the AIFSRC sees as vital for the health of future generations in Africa. ■

ACIAR projects: FSC/2012/023, FSC/2012/111
<http://aciar.gov.au/aifsc>

More information: Mellissa Wood, director, AIFSRC, mellissa.wood@aciar.gov.au; Dr Richard Markham, horticulture research program manager, richard.markham@aciar.gov.au; Dr Mike Nunn, animal health research program manager, mike.nunn@aciar.gov.au

THE NUTRITION

Nutrients essential to life flow from soils and oceans into plants and through the food chain to fish, animals and humans. As such, soils serve as one of two essential foundations to the nutrition cycle. At ACIAR, this leads to the view of nutrient levels in soils as a bank account: "You can withdraw what you have, but once the nutrients have been depleted, you need to replace them," says Dr Gamini Keerthisinghe, former manager of ACIAR's Soil Management and Crop Nutrition research program. Maintaining a healthy soil "bank balance" is a cornerstone of ACIAR farming projects that provides a strong foundation for improved crop productivity, human nutrition and farmers' income.

MINERAL DEFICIENCIES

CASE STUDY: South-west Tibet. Surveys of soil, livestock and plants in seven livestock-producing counties in Tibet identified soil mineral deficiencies leading to some significant risks of animals' suboptimal mineral intake through forage. Deficiency in one mineral—selenium—was particularly problematic, with this deficiency the most widespread and severe mineral deficiency in Tibetan livestock. Earlier surveys identified most of the eastern and lower-western parts of Tibet as low-selenium areas.

Jilak yaks foraging in these areas have alarmingly low blood levels of selenium (8 to 32 micrograms per litre of blood compared to normal levels of 75 to 120) resulting in reduced fertility, growth and production and the amorphous condition known as 'ill thrift'. In humans, low selenium intake can result in endemic levels of the heart condition Keshan disease and an osteoarthropathy, Kashin-Beck disease.

It is suspected that adverse effects from low selenium intake are somewhat mitigated by a local adaptation, which involves accumulation of relatively high vitamin E levels. Selenium and vitamin E share certain physiological functions and each can partly compensate for lack of the other in humans and animals. Yak meat and butter supply good levels of bioavailable vitamin E, along with vitamin A, B vitamins (including B12), zinc, iron and desirable fatty acids. This nutrient profile makes yak meat one of the healthiest meats and it is extremely popular in Tibet.

Larger-framed imported cattle, with higher feed requirements, would not have this (theorised) tolerance to low selenium, so would require greater care with nutrition (in terms of quantity and quality) than yaks and the native Tibetan cattle. A balance needs to be struck between lower genetic capacity and adaptive advantage.

With completion of the mineral surveys, activities progressed to a new phase of supplementation trials both via direct provision of slow-release mineral supplements and the provision of mineral blocks at one township, Duopozhang.

The trial was well received by the participant households, with the blocks associated with about a 20% increase in milk and butter production from about three months after trial commencement,

a desirable yellower milk and butter colour, improved coat colour, increased fertility, and the cattle "eat more and are sick less often".

A more controlled assessment of effects is being planned with a 50-head dairy herd at the Tibet Academy of Agricultural and Animal Sciences in Lhasa, before expanding the use of supplement blocks to the wider community.

ACIAR project: LPS/2010/028

"Collaboration with Australian researchers has been enormously valuable for the Tibetan scientists."

— Dr Nyima Tashi, project leader from the Tibet Academy of Agricultural and Animal Sciences



PHOTO: 123RF.COM

CYCLE

"Formerly we were buying 10 bags of commercial fertiliser. But now we are purchasing only 5 to 6 bags because we are benefiting by using chicken manure. We are very happy with our accomplishments as farmers because we were able to pay for our children's college education."

—Vegetable farmer Samuel Gadrinab worked with the ACIAR research team in the Philippines to reverse crop yield decline caused by depleting soil nutrients.



PHOTO: GORDON ROGERS

SOIL EROSION

CASE STUDY: Southern Philippines. Vegetable production had been steadily declining as population growth depleted nutrients from available arable land. Sloping land and intense rainfall during the wet season strained the soil bank through erosion.

10-12 tonnes of soil a year = the tolerable level of soil erosion, estimated by Jun Mercado of the Claveria Research Centre.

350 tonnes of soil a year = the amount of soil carried away by monsoonal erosion if farmers plough up and down a slope.

2-6 tonnes of soil a year = the level of erosion achieved through farmer adoption of two innovations: contour ploughing (ploughing along the slope's contour lines rather than up and down a slope) and cultivating high-value crops such as abaca, lakatan, pineapple and bananas as natural vegetative strips to form hedgerows at the contour's edge.

With erosion abated, extension workers were trained to accurately test soils for nutrients—such as nitrogen, phosphorus, and potassium—using

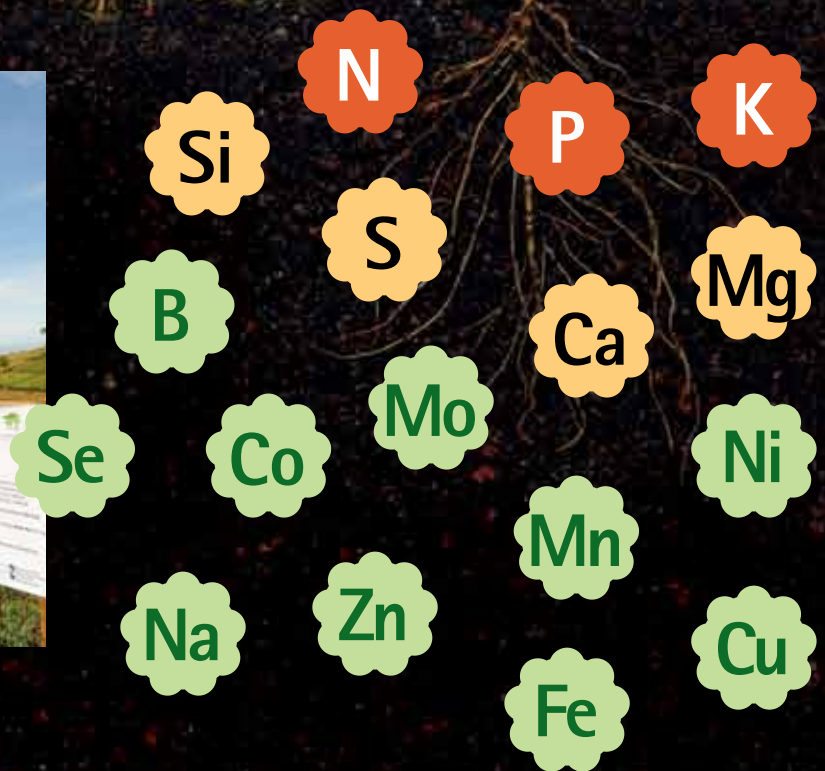
simple soil test kits. Once nutrient levels were known, cost-effective soil improvement programs were developed. That knowledge was passed on to farmers through activities such as ACIAR Farmer Field Schools.

Vermicompost was also applied to improve soil fertility. Food sources for worms (such as wild sunflowers) were chosen to make vermicompost that would also aid in pest and disease control.

ACIAR project: HORT/2007/066

"Based on our experience, we recommend a combination of organic and inorganic fertiliser, which we call integrated nutrient management."

—Jun Mercado, who holds regular field days to showcase new technology at the Claveria Research Centre in the Philippines



Small fish, big impact

Fish play a vital role in nutrition and economic activity in South-East Asian and Pacific regions, where people eat two to four times more fish than the global average

BY DR CHRIS BARLOW

Small fish are the most important source of nutrition in countries of South-East Asia and the Pacific where fish are a traditional part of the diet. Small fish are plentiful, comparatively cheap and can be cooked and eaten whole. Eaten this way, they are easy to digest and provide good quantities of protein and essential minerals and vitamins, including calcium, iron, zinc and vitamin A.

Although diets are changing in these countries, fresh milk is still comparatively uncommon, so fish remain the major source of calcium for many mothers and babies.

Fish also make a significant contribution to the economy, particularly through small-scale fisheries and aquaculture (farming) in marginalised and vulnerable communities. Women play a major role in these industries, particularly in fish processing.

ACIAR has long recognised the importance of healthy capture fisheries and aquaculture to improve nutrition, employment and economic opportunity.

ACIAR's fisheries research covers offshore fisheries, estuarine and river fisheries, freshwater fisheries in lakes and dams, and aquaculture of marine and freshwater species (fish, molluscs and crustaceans).

Increased production and sustainable resource management are constant themes of this research, with the ultimate aim being to improve the livelihoods of potentially many millions of people. ■

ACIAR projects: FIS/2008/023, FIS/2009/041, FIS/2010/055, FIS/2010/058, FIS/2011/013, FIS/2011/052, FIS/2012/100

More information: Dr Chris Barlow, fisheries research program manager, chris.barlow@aciarc.gov.au

In Lao PDR, fish populations and movement are affected by man-made barriers on streams, such as weirs and irrigation structures. ACIAR research is determining ways to allow fish to migrate past low-level barriers and give them access to flood plains for breeding. This should increase the availability of fish to remote rural communities that rely on them.

PHOTO: JIM HOLMES





PHOTO: ERIC BARAN

In Burma, dried fish and shrimp are a staple part of diets for people living both near and far from sources of fresh fish. ACIAR is working with authorities to develop inland capture and culture fisheries and co-manage these fisheries with local communities.

PHOTO: ERIC BARAN

PHOTO: JES SAMMUT



In Cambodia, small fish are eaten at almost every meal; fresh, smoked, dried or as processed fish paste. ACIAR research is determining how to increase the health and livelihood values of Mekong fisheries for poor and vulnerable social groups. Here, fish are being processed for sun drying.



In Papua New Guinea highlands, where food insecurity is an issue, farming fish such as tilapia in small ponds is a rapidly growing small-scale industry. ACIAR is facilitating programs on "fish for schools" and "fish farming in prisons". Here, prisoners from Bihute Prison are harvesting their farmed fish.

Crop diversification and nutrition

As nations prosper, diets invariably change and diversify in ways that chart pathways out of poverty and malnutrition for subsistence rice farmers

BY WARREN PAGE

Rice provides 71% of the average daily calorie intake for most people in Burma. The per-capita rice consumption—190 kilograms a year—is the highest in the world. Much of this rice is grown in Burma's Ayeyarwady Delta and Bago regions during the monsoon season, with more than 3.2 million hectares planted. In the non-monsoon months, a second rice crop is planted, or alternatively a pulse crop such as black or green gram.

With economic prosperity and the shift from agrarian to urbanised societies, diets become more diversified. This is occurring in countries such as China and Indonesia.

As Peter Timmer, a leading development economist, points out, "no country has been able to sustain a rapid transition out of poverty without raising productivity in its agricultural sector".¹

A key factor in this transition is the shift of the greater part of a country's population from agriculture to other work, according to economist David Dawe² from the International Rice Research Institute.

In Burma, 73% of the population lives in rural areas, with one-third of the population living in poverty. In 2010, 35% of Burmese children younger than five years had stunted growth.³

However, the examples of rural-to-urban migration in China and Indonesia suggest Burma is on the cusp of a large-scale transformation in the demographics of the country. Already, millions of Burmese work in neighbouring countries' cities, and Burma's own cities are growing. This situation is likely to accelerate with the recent political and economic reforms.

In both China and Indonesia, economic reforms supported the transition from rice production to more diversified farming. The increased diversity of farm production has helped millions of people in both these countries move from poverty and subsistence rice farming to a better life.

Growing rice at a subsistence level is known to be a poverty trap. Farming is restricted to the growing of rice to feed families and provide seed for following crops, without generating

sufficient income to break this cycle.

This trap also has serious implications for nutrition intake. A 195-gram serve of long-grain, cooked brown rice provides 11% of the recommended daily calorie value (based on an adult diet of 2,000 calories a day). The same serving provides no vitamin A, C or D intake, only 5% of recommended daily iron value, 2% of daily calcium and no vitamin B12 value. Yet for most people in Burma, rice is the main staple, providing almost three-quarters of their daily calorie intake. So how can this situation change?

A common approach to breaking the poverty trap and improving dietary intake is diversifying farm production. The success of

diversification mainly depends on inclusion of higher value, non-rice crops within rice-based farming systems. Applied correctly, this approach increases the overall productivity and provides additional income for farmers and their families.

On a larger scale, diversification of production can accelerate economic growth, creating markets and the beginning of the transition out of poverty and towards prosperity.

The experience of ACIAR projects elsewhere, such as Cambodia, has seen farmers improve rice yields and expand into other crops, increase their livestock numbers and begin to focus on supplying markets.

However, the complexities around farm

PHOTO: DAVID HERRIDGE, UNIVERSITY OF NEW ENGLAND



A smallholder farmer with her basket of freshly harvested groundnut in Burma's central dry zone.

size, varying soil types and climate, agricultural inputs, seed varieties and traditional customs mean that no one solution fits each country or farm. Selection of the crops and management strategies best suited to local conditions needs research and careful planning.

In Cambodia, tailoring research to the specifics of local climatic conditions, agronomic skills and nearby markets has helped farmers diversify production into maize and other valuable crops.

In Burma, ACIAR projects are similarly focusing on providing locally appropriate ways to enhance crop yields and introduce crop diversity. The aim is to not only enhance productivity and provide income opportunities, but to also improve diets through access to increased nutrition.

Legumes are the second-most-important group of crops in Burma, after rice. They are a major source of protein, minerals and vitamins, so improving legume productivity is potentially one of the most successful strategies to improve nutritional security.

ACIAR research into enhancing legume production in Burma's central dry zone has been running since 2007. It has provided

farmers with higher yielding crops and improved rhizobial inoculants for natural fertiliser, and established the country's first village-based seedbanks. The improved varieties of chickpea, groundnut and pigeon pea yield as much as 35% more than traditional varieties and are being readily adopted by farmers. The work is now being built on to capitalise on its achievements and will also inform other projects in Burma.

In the Ayeyarwaddy Delta, opportunities for smallholder farmers to increase diversification in rice–rice and rice–pulse cropping are being examined. This research is determining best practice for crop selection and management to both increase and sustain crop yields. The adoption of new rice varieties and alternative management options by farmers in the delta will allow them to advance their rice harvest and also have better options for post-rice crops such as black gram.

For many poor farmers in Burma, crop diversification will play an important role in escaping poverty and lifting their daily nutrition intake towards recommended levels. Younger family members may especially benefit from opportunities to access improved nutrition. ■



Inspecting new pigeon pea lines in Burma's central dry zone.

ACIAR projects: AH/2011/054, ASEM/2011/043, FIS/2011/052, SMCN/2006/013, SMCN/2011/046, SMCN/2011/047

More information: Dr Robert Edis, soil management and crop nutrition research program manager, robert.edis@aciarc.gov.au

The 2014–15 annual operational plan for Burma can be viewed at: <http://aciarc.gov.au/files/aop2014-15/east-asia-burma.html>

1. *Agriculture and Pro-Poor Growth: An Asian Perspective*. C. P. Timmer 2005. Centre for Global Development, Working paper No. 62.
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PHOTO: DAVID HERRIDGE, UNIVERSITY OF NEW ENGLAND



Smallholder farmers partaking in an ACIAR survey in the central dry zone of Burma.

Food safety from farm to fork

A risk assessment approach to food safety in Vietnam is helping reduce risks of people contracting disease from pork products

BY DR WENDY HENDERSON

Food-borne disease is a major public health issue in Vietnam and other developing countries. In addressing food safety, a balance must be achieved between supplying the population with safe food and protecting the smallholder producers from unreasonable costs of doing so.

Contamination of popular foods in Vietnam, such as pork and vegetables, can occur all along the food value chain—anywhere from farm to fork. But just because a harmful substance or organism is present in food it does not necessarily mean it will cause illness. It is important to understand how and where the real food safety issues arise to work out the best options to prevent food-borne disease.

In Vietnam, risk assessment (RA) is emerging as a useful and innovative approach to manage food safety. This approach assesses the potential harm from disease-causing organisms or substances in food and estimates the likelihood that this harm will actually occur, all along the food pathway. It then identifies the critical points and management strategies that need to be applied to eliminate or minimise the risk.

The theory of RA is all well and good, but in Vietnam there is a lack of local capacity to apply it. The need is urgent, especially for Vietnam's many wet markets, which are informal and unregulated.

Enter the RA task force for food safety, a new initiative to strengthen local capacity. The task force is bringing RA experts together with representatives from the ministries of health, agriculture and rural development. Through this connection, policymakers and implementers are gaining a better understanding of why RA is useful and how it can be used to effectively manage food safety.

One such expert is Dr Hung Nguyen-Viet, a scientist from the International Livestock Research Institute (ILRI) and deputy director of the Center for Public Health and Ecosystem Research at the Hanoi School of Public Health. He initiated the RA task force and is coordinating an ACIAR project using RA to reduce disease risk and improve food safety in smallholder pig value chains in Vietnam, being implemented by ILRI and Vietnamese partners.

Dr Nguyen-Viet was also a recipient of ACIAR's John Dillon Fellowship of 2014, awarded to agricultural research managers at the forefront of their field. The Australian Minister for Foreign Affairs, The Hon. Julie Bishop MP, presented him with his award in March this year.

"Research on the pork value chain has highlighted hot spots for disease control," Dr Nguyen-Viet says. "For instance, it found that slaughterhouses are a major contamination

point, particularly for the food-poisoning bacteria *Salmonella*."

The most common culprit for spreading these bacteria is the workers' hands. This information suggests a good starting point for management would be to target slaughterhouse workers' hygiene practices (e.g. emphasising hand washing) to reduce the risks of *Salmonella* poisoning.

The studies by ILRI have also brought surprises along the way. Analyses of pork sold in supermarkets and wet markets found that meat is often more highly contaminated in supermarkets. This is most likely because meat tends to sit on supermarket shelves longer before sale, allowing bacteria to multiply (even in refrigeration). The result has changed the mindset on the perceived riskiness of wet markets versus supermarkets.

Another study of household cooking and eating habits in Hanoi revealed that people's food-preparation methods put them at risk of spreading contamination from raw pork to other foods. But since it is extremely difficult to change the behaviour of millions of meal-makers, the best interventions to improve this situation should be made before consumers even buy their meat. Dr Nguyen-Viet says interventions should also be incentive-based for different stakeholders involved in the pork value chain.

Dr Nguyen-Viet's research is providing invaluable evidence and insights to inform pork safety policy and practices in Vietnam. Further research will be needed to assess health-related risks in other important foods and identify the best options to manage them. Lessons learned will be useful not only to Vietnam, but also to other similar countries. Using RA is going to have a significant impact on the health of millions of people. ■

ACIAR project: LPS/2010/047

More information: <http://pigrisk.wikispaces.com>



PHOTO: ACIAR

(From left) Dr Hung Nguyen-Viet visiting a dairy farm in Wagga Wagga, New South Wales, with two other John Dillon Fellows, Dr Hassan Warriach (from Pakistan) and Dr Yingun Zhang (from China).



PHOTO: NGUYEN NGOC ILRI

A pork vendor at the wet market sells her meat to two local women, Hung Yen province, Vietnam.



PHOTO: EMMA ZALCMAN

Mixed-breed pig in a Lao village.

Healthy pigs, healthy people

In many developing countries, free-ranging animals live closely with people resulting in some villagers contracting zoonotic diseases (diseases that can affect both humans and animals). An ACIAR project in Lao PDR recently found that zoonotic worms in pigs are particularly common in some villages.

These include *Taenia solium*, a tapeworm that can cause significant brain damage in people and several gastrointestinal worms that consume vital nutrients and contribute to a range of nutritional deficiencies, which can be especially detrimental to children.

The project team, which includes staff from the Lao Ministry of Health and the Department of Livestock and Fisheries, embarked on a mass drug administration to treat the worms in pigs and people in one of the villages. Two rounds of treatment have been completed and early monitoring suggests that the number of worms present among villagers has significantly decreased. Several villagers that were interviewed have reported feeling much better.

Ongoing monitoring will further assess health and nutrition benefits. The team is also investigating other risk factors that may contribute to the high levels of worm infection, including the cultural practice of consuming raw pork. — EMMA ZALCMAN

ACIAR project: AH/2009/001

When less is more

ACIAR research is shining light on how to successfully grow crops and teak together in Lao PDR

BY JANET PATERSON

Small teak plantations scattered across 25,000 hectares of northern Laos represent important 'green banks' for the landholders who manage them—with individual trees harvested and sold to cover hefty family expenses, such as education and marriage costs.

Due to assumptions that every tree can be sold at a good price, many smallholders have unsurprisingly come to believe that more is better when it comes to teak planting density.

Consequently, many farmers in Laos have established their teak plantations at densities many times over the optimal rate, which unfortunately has resulted in small-diameter, slower growing trees of less value.

ACIAR has a 20-year history in teak forestry research across Asia and the Pacific and is working with Lao farmers to demonstrate the productivity value of lower plantation densities.

ACIAR forestry research program manager Tony Bartlett says land conservation policies introduced by the Lao government in the late 1990s stimulated extensive teak plantings across the small east-Asian country.

"In an effort to reduce slash-and-burn cultivation and rehabilitate deforested land, householders were allocated tracts of public land on the proviso they planted smallholder teak plantations," Mr Bartlett says.

Despite local forestry officers recommending a stocking rate of 1,100 trees, the Lao growers often planted more than 2,000 trees per hectare—falsely assuming that more trees would mean more eventual income.

When ACIAR researchers from the University of Queensland became involved with the northern Lao farmers near Luang Prabang many of the teak plantations were 10 to 15 years old and it was apparent that they were far too heavily stocked to get the best growth.

On-farm research trials were established to determine whether thinning would lift the



PHOTO: TONY BARTLETT

Bounkieng Souliyasack from the Northern Agriculture and Forestry College pruning three-year-old teak in the Nelder wheel trial.

productivity of the remaining trees.

"Thinning the trees was problematic because there is no real market for the large volumes of small-diameter logs and growers cannot justify the labour costs involved in harvesting the low-value wood," Mr Bartlett says.

The research team also found that thinning

such advanced plantations did little to improve the growth rate of the remaining teak trees.

"We found that thinning really needs to take place before the eight to nine-year mark to have a sizeable impact on the diameter growth of the remaining trees," Mr Bartlett says.

What was needed was a clear demonstration

of the value of planting teak at the correct density so that growers embarking on new plantations could establish and manage them to achieve the best-value logs.

NELDER WHEELS

In 2008, ACIAR researchers established demonstration plantations using a special planting pattern known as a 'Nelder wheel'. Using this approach, teak is planted in rows along the 'spokes' of a wheel shape, which results in a range of tree densities from high in the middle of the wheel through to low on its outer circumference.

"By monitoring the Nelder wheel trees over five years, researchers were able to determine the average growth of the teak at different stocking rates—from 100 to 2,500 trees per hectare," Mr Bartlett says.

The research showed that the best stocking rate for maximum tree diameter and height was 600 trees per hectare.

"This was about a third of the number of trees traditionally grown per hectare," Mr Bartlett says.

Farmer workshops at the Nelder wheel demonstration sites were held in early 2013 to show local growers the value of planting at the optimum density.

"Being able to demonstrate the impact of various tree densities in the one trial allows growers to see the different teak production results with their own eyes. And there is nothing like personal experience to generate practice change."

Demonstration thinning trials established on land owned by a local community leader were also very well received with growers able to see how thinning at the correct time stimulated the growth of the remaining trees.

"We found markets for the thinned trees as poles for ecotourism huts and small logs for furniture production, so the thinning generated a profit as well as improving the productivity of the remaining stand."

A new five-year ACIAR project that began in mid-2013 will further extend the results of the Nelder wheel trials.

"The first five years of the project were about getting the science right—we needed time to understand how density and thinning impact teak production," Mr Bartlett says.

"Now we will engage more villages and farmer groups to demonstrate the Nelder wheel results and help them market the thinned poles and mature trees."

LUMPY INCOME

Establishing teak plantations at a lower density also gives farmers the option of growing crops between trees to improve short-term cash flow.

"Traditionally the Lao farmers have planted 1,800 to 2,500 trees per hectare, which means they can only farm the land between the trees for three or four years before shade inhibits the understory crops," Mr Bartlett says.

"This can make life difficult for farmers who don't have enough land to grow crops somewhere else while their teak trees mature to a size of high value."

In 2013, ACIAR researchers trialled a range of crops including maize, pigeon peas, soybeans and cassava under the different teak spacings in the Nelder wheel.

"The researchers engaged the local farmers to determine what crops they would like to grow and then established trials of these crops in the spokes of the Nelder wheel."

Early results indicate the preferred crops can all be grown very successfully at a teak stocking rate of 600 or less per hectare.

"We will monitor the incomes of the growers over the life of the project to determine which combination of crops generates the highest income."

The integrated crop-teak system provides a triple benefit to farmers: the trees grow faster to high-value size, crops can continue to be planted between maturing trees, and non-commercial tree thinning is no longer needed.

ACIAR has a 20-year history in teak forestry research across Asia and the Pacific and is working with Lao farmers to demonstrate the productivity value of lower plantation densities.

"Growers can be paid high prices for high-diameter teak and every 10-centimetre increase in diameter results in an exponential rise in log value," Mr Bartlett says.

But with no fully established teak furniture industry like their Indian and Indonesian counterparts, markets for teak in Laos remain a challenge.

"Furniture production from plantation wood is still a work in progress—we need to better understand the cutting and drying requirements of plantation wood to generate a good-quality wood product," Mr Bartlett says.

"Export furniture markets require high-quality wood, which the Lao landholders and processors are not yet able to deliver, and the ACIAR team is investigating other markets for the smaller plantation logs."

Suggested markets for the smaller trees include charcoal as an energy source and veneer wood for construction. ■

ACIAR project: FST/2004/057

More information: Tony Bartlett, forestry research program manager, tony.bartlett@aciar.gov.au



PHOTO: TONY BARTLETT

Lao farmer Khamson Phonsavanh worked alongside ACIAR teak project staff to develop his agroforestry system. The system involves paired rows of teak, with banana, broom bush and some upland rice planted in the spacing between the paired rows. Mr Phonsavanh says he is happy with the teak trees, which are now four years old, as he knows that they will provide him with a good return and in the meantime he can still earn some income from the integrated crops.

Small logs produced from thinning a 17-year-old teak plantation at Ban Kok Gniew.

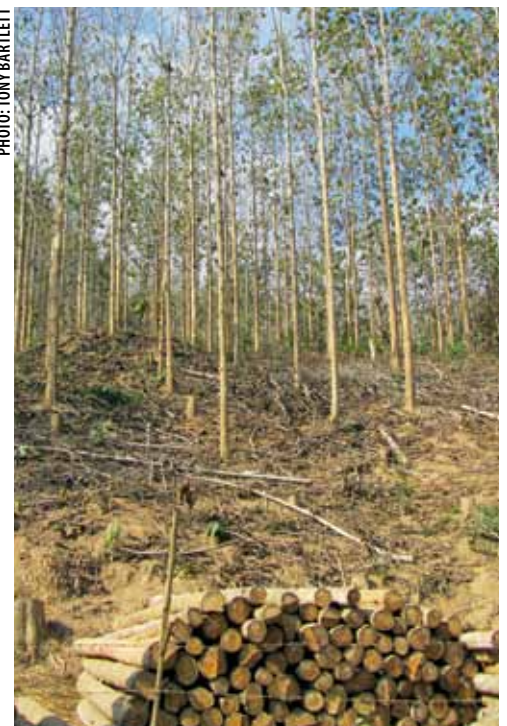


PHOTO: TONY BARTLETT



Farmer Long Yang.

PHOTO: BRAD COLLIS

MAKING THE MOST FROM CHANGE

ACIAR research in Lao PDR is helping smallholder farming households adapt to natural resource pressures

BY DR WENDY HENDERSON

Lao PDR, although a land-locked country, is generously endowed with natural resources. The government is exploring development of these resources for economic growth in the country. Such development has potential positive and negative effects on local rural communities.

An ACIAR project led by Dr Philip Hirsch from the University of Sydney is exploring ways that smallholder households can capture opportunities that arise from such changes and become more resilient to natural resource pressures. The research is focused on the Nam Ngum River Basin in Laos—a large catchment with a history and ongoing experience of natural resource development inducing livelihood changes.

“The project involves multidisciplinary teams working on understanding and improving the links between intensified natural resource use, food security, health and nutrition,” says Dr Caroline Lemerle, manager of ACIAR’s Agricultural Systems Management research program.

Research activities include geographical

analysis, livelihood surveys, and stakeholder and policy analysis.

The geospatial analysis group has analysed environmental change, resource development patterns and demographic changes across the Nam Ngum River Basin. The analysis looked at changes over time in land use, land cover, population movement, density of urbanisation (such as aggregation of people in towns along roads), and how these changes affect people’s access and competition for resources.

Household surveys on livelihoods, food security, health and nutritional status have just begun. The surveys include an investigation into families’ dietary intake (assessing varieties and sources of food at different times of the year) and physical growth indices of women and children.

These surveys will also provide an understanding of people’s assets (physical,

natural resources, financial, community/social and personal) in terms of their quantity and accessibility, and people’s capability to use them.

Together with the spatial and policy analyses, the household survey results will provide a clearer picture of the relationships between resource pressures, household wealth, food security and health.

“The information will enable the identification of the people most at risk of food insecurity and malnutrition,” Dr Lemerle says. “Most importantly, it will help these people develop appropriate livelihood strategies for their families and communities.” ■

ACIAR project: ASEM/2009/055
More information: Dr Caroline Lemerle, agricultural systems management research program manager, caroline.lemerle@aciar.gov.au

The information will enable the identification of the people most at risk of food insecurity and malnutrition. Most importantly, it will help these people develop appropriate livelihood strategies for their families and communities.

KEY MESSAGES FROM NEW STRATEGIC PLAN

BY WARREN PAGE

Australia's Minister for Foreign Affairs, The Hon. Julie Bishop, states that the *ACIAR Strategic Plan 2014–18* “responds to urgent global challenges, and sets out ACIAR's distinct contribution to the global research effort.” Minister Bishop also notes that the plan confirms ACIAR's commitment to contribute to sustainable economic growth and reduce poverty in partner countries through partnerships that will improve gender equality and achieve more productive and sustainable agricultural systems.

Speaking at the plan's launch in February, the Parliamentary Secretary to the Minister for Foreign Affairs, Senator The Hon. Brett Mason, noted ACIAR's role in delivering sustainable results that change lives.

“Everyone in the aid sector is familiar with the old saying ‘give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime,’” Senator Mason said. “This has increasingly been the dominant aid paradigm for the past decade or two—capacity building, as opposed to hand-outs.

“The reason why I see ACIAR as such a fantastic initiative is that it takes the practice even further. To build on the analogy, it doesn't give our friends across the Indo-Pacific fish, and it doesn't just teach them how to fish.

“What it does is teach them how to build fish farms, so that not only will they be fed for a lifetime, but they will have enough money to send their kids to school, they will be able to create jobs for their neighbours, grow their communities, and bring prosperity and stability to the regions in which they live.”

The plan outlines how ACIAR aims to deliver productivity gains that help create opportunities for smallholder farmers to transition into sustainable, market-oriented production, by:

- developing new, demand-led technologies to help smallholders produce appropriate goods and to access existing and new markets;
- building partner-country scientific capacity, for the development of new scientific knowledge, to support on-farm productivity for smallholders; and

- building capacity among decision-makers in evidence-based policy formulation, to create a policy environment conducive to market development.

There are many success stories in Australia's region that demonstrate the power of markets and trade: China, India, Indonesia and Vietnam. In each case, economic development has been backed by good science and supportive policies.

Agriculture remains a key component of developing economies—supporting livelihoods and acting as a catalyst for economic growth. Stronger regional economies bring opportunities for increased trade, for continued growth and, in agriculture, for inclusive markets open to smallholder producers.

ACIAR has been conducting market-focused research with smallholders in a wide range of countries to build their capacity to successfully engage with markets. Key examples include the Australia–Pakistan Agriculture Sector Linkages



The *ACIAR Strategic Plan 2014–18* (<http://aciar.gov.au/publication/cp027>) was recently launched by the Australian Government. The plan describes ACIAR's efforts to help smallholder farmers access and engage with markets, as well as initiatives to improve the scientific capacity in partner countries.

Program and the Pacific Agribusiness Research for Development Initiative.

The *ACIAR Strategic Plan 2014–18* will orient ACIAR's work to deliver similar market opportunities to even more farmers. It will ensure ACIAR is a valued contributor to the Australian Government's approach to overseas development assistance, building economic prosperity in the Indo-Pacific region. ■

PHOTO: CONOR ASHLEIGH



A vegetable farmer delivers a carton of tomatoes to a market stall at the Suva fruit and vegetable market in Fiji.

Solving food insecurity: BEWARE OF UNINTENDED HEALTH IMPACTS

BY ASSOCIATE PROFESSOR RUTH COLAGIURI AND DR SI WIN TIN*

If ever there were a core arena of endeavour where a multiplicity of scholarly disciplines and technical expertise should come together, it has to be food security.

Applying joined-up systems-level research, policy, technical and practical solutions is essential to tackling societal problems of this magnitude. Such an approach will assist in successfully managing both the intended and unintended consequences of intervening to deliver food security in rapidly changing and dynamic contexts.

There is a role here for not only soil, water and energy scientists, agriculturalists, horticulturalists and veterinarians, food technologists, engineers and logistics experts, but also for public health and policy specialists, lawyers, urban planners and architects, behaviourists and many others.

Why complicate the task with so many different perspectives and agendas? Why not just secure a food supply chain to famine areas? Or to the 66 million primary-school-aged children across the developing world who go to school hungry every day—and who are therefore at greater risk of retarded neurological and physical development and more likely to die from common infectious diseases than their well-nourished counterparts?

What about undernourished pregnancies? Retarded growth in the womb and underweight at birth sets up susceptibility to infectious and chronic diseases and early mortality. The first 1,000 days (nine months in the womb and the two years after birth) are vital to optimal growth and development and a healthy adulthood.

Even leaving aside extremes such as starvation and retarded development, the ways in which undernutrition can affect human health are virtually unlimited. So, by all means we should work as hard and as fast as possible to solve food insecurity. But, we should think it through carefully because, despite the obvious

benefits to sustainable human development, as the saying goes, “there be dragons”.

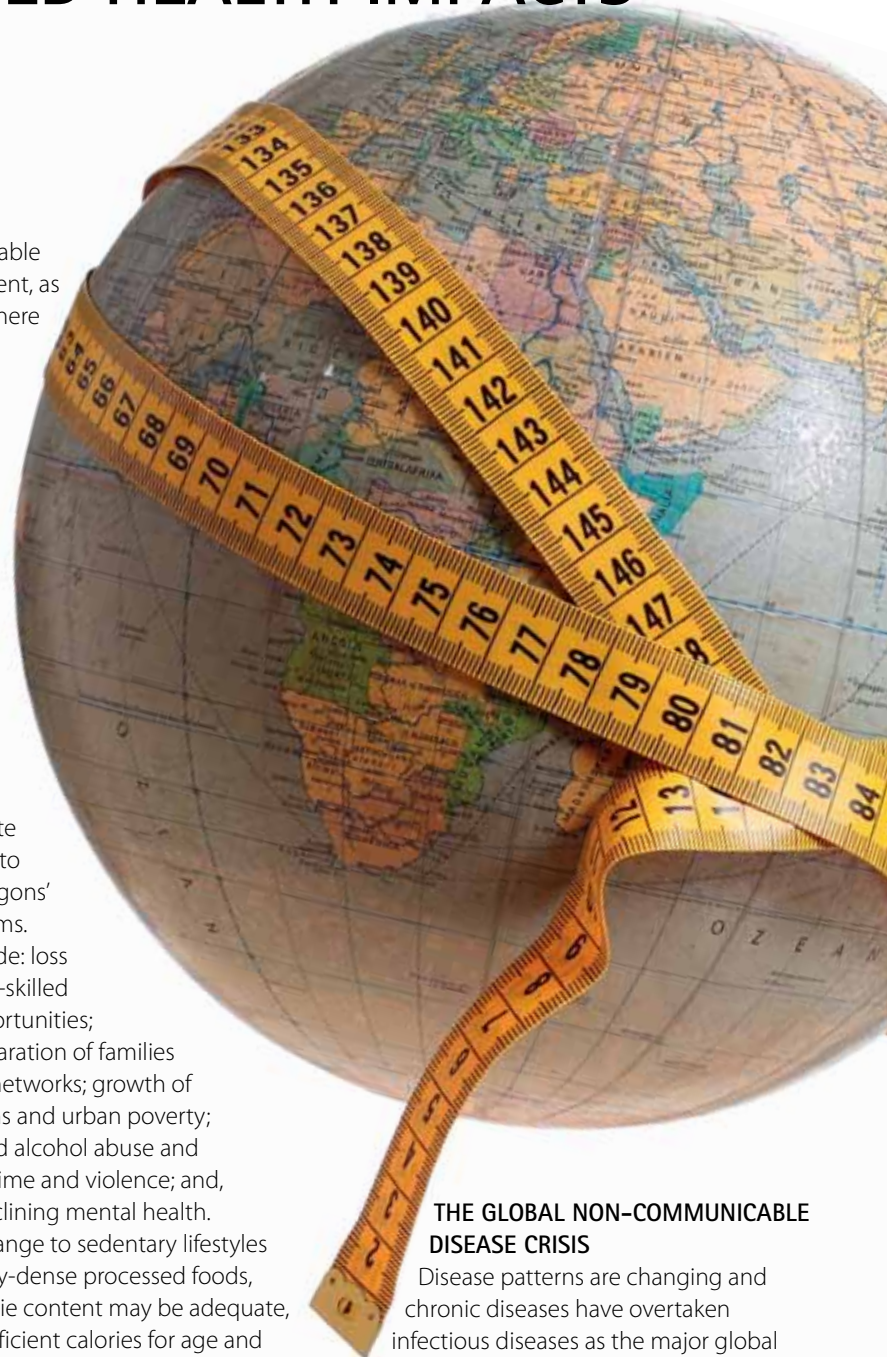
DEVELOPMENT 'DRAGONS'

Countries that have undergone rapid industrialisation and urbanisation have repeatedly demonstrated that, as people leave their traditional farmlands and villages and migrate virtually en masse to urban centres, ‘dragons’ can take many forms.

Examples include: loss of unskilled or low-skilled employment opportunities; displacement; separation of families and loss of social networks; growth of overcrowded slums and urban poverty; increased drug and alcohol abuse and increased street crime and violence; and, unsurprisingly, declining mental health.

The sudden change to sedentary lifestyles and diets of energy-dense processed foods, although the calorie content may be adequate, is problematic. Sufficient calories for age and stage of the life cycle, gender and energy output are essential for good nutrition.

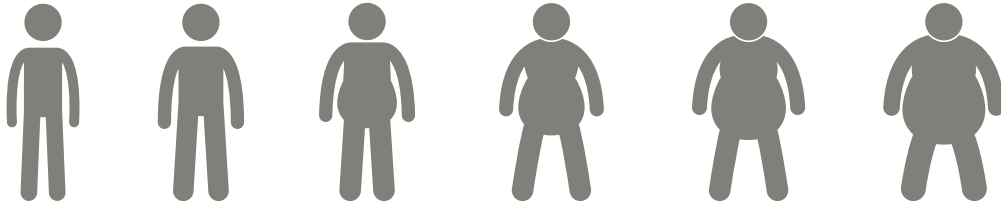
However, without the right balance and quality of macronutrients and micronutrients, calories are not in themselves sufficient for normal growth and development, disease resistance, strength and resilience. Further, it is entirely possible for individuals to remain malnourished (i.e. lacking essential nutrients) even when overweight or obese, and with that comes another set of problems.



THE GLOBAL NON-COMMUNICABLE DISEASE CRISIS

Disease patterns are changing and chronic diseases have overtaken infectious diseases as the major global killer. With big-population countries such as China, Brazil and India lifting people out of poverty at astonishing rates, the proportion of the world's population living in extreme poverty is declining.

Concomitantly, rapid uptake of technologies for mechanised and mass food production in the developing world is both enabling and encouraging unprecedented migration from rural communities to cities. Here employment (if available at all) is likely to be sedentary, and



The main culprits are cardiovascular disease (CVD)—most commonly heart attack and stroke—diabetes, cancer and chronic lung diseases. Together, each year, they cause more than 60% of the world's deaths, incalculable disability and trillions of dollars in lost productivity, so it is little wonder they are in the UN spotlight.

energy-dense nutrient-deficient 'junk food' may be the only affordable option. This leads to obesity and dramatic increases in chronic or non-communicable diseases (NCDs), which fuel continuation rather than alleviation of poverty.

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Once thought of as diseases of affluence and old age, these conditions are increasingly occurring in people in the productive years (35 to 64 years), and in developing countries where 80% of the premature deaths due to NCDs are concentrated. Death from NCDs is often preceded by long years of illness and disability. In countries with no universal healthcare protection, loss of employment combined with the treatment costs can potentially plunge or keep whole families entrapped in the poverty cycle.

While there is a genetic component to NCDs, their stellar rise to global health crisis status over the past few decades is not about genes. Genes do not change that quickly. It is about increased exposure to toxic, diabetogenic and obesogenic environments, which are largely politically and economically driven. There are lessons to be learnt from across the developing world, as the examples below dramatically illustrate.

NAURU AND CUBA: ECONOMIC INFLUENCES ON UNDER AND OVERNUTRITION AND NCDs

In the early 1990s Cuba suffered severe food shortages due to a politically driven economic crisis. The Cuban famine is famous in international health circles because it led to a rapid average weight loss of 4 to 5 kilograms per adult across the population. Famine is a tough way to lose weight and many of the Cubans who survived it suffered irreversible disability and damage to their health.

Nonetheless, there was a 'silver lining' in the form of a substantial decline in deaths from diabetes and CVD—presumably due to the weight loss.

The rise and fall of diabetes in the tiny Pacific Island of Nauru makes the same point. Until the discovery in the early 1900s of large phosphate deposits, Nauruans lived physically active lives based around subsistence fishing and agriculture. NCDs—particularly diabetes—were virtually unknown.

By the height of the phosphate mining boom in the 1970s, Nauruans were the richest people on earth per capita but, sadly, their 'overnight' westernisation brought on a massive burden of obesity and a diabetes prevalence of about 30%. By the late 1900s, the phosphate wealth was replaced by economic hardship and subsistence lifestyles. In the early 2000s, a World Health Organization (WHO) survey estimated the diabetes prevalence at about 16%—a massive fall from the 1970s figure.

WHAT ARE THE LESSONS FOR FOOD SECURITY?

Where development has occurred at a rapid rate, agricultural intensification and diversification are needed. Take Africa, the continent with the highest prevalence of hunger, as an example. Africa is poised on the brink of an 'overnight' agriculture revolution.

In barely one generation it is set to experience a morphosis from mass undernourishment (currently more than 40% of the population in some countries) to being able to feed itself and potentially export food—a journey that took the western world some 200 years. This is nothing short of miraculous but, if not managed carefully, stands to transport millions of Africans from an undernourished/infectious disease 'frying pan' to an NCD 'fire' of unprecedented proportions.

Africa has traditionally been infamous for its burden of infectious diseases such as tuberculosis, malaria and HIV/AIDS. Achieving food security will no doubt help to mitigate this. However, even in the presence of food

insecurity, Africa already has a substantial burden of NCDs. For example, an estimated 19.8 million (4.9%) of adults in Sub-Saharan Africa have diabetes. The highest prevalence is on the island of Reunion (15.4%), followed by the Seychelles (12.1%), Gabon (10.7%) and Zimbabwe (9.7%).

In contrast, Australia's diabetes prevalence is about 7.4%. Clearly, Africa already suffers a classic 'double burden' of infectious and non-communicable diseases. Many African countries have little infrastructure for transport, logistics, good governance, public policy, health, education, transport or urban planning. How will they cope with the social disruption, ill health and over-urbanisation that will result from overnight transformation from subsistence to mass food production?

According to WHO, a substantial proportion of NCDs (80% of diabetes and CVD) is preventable. The UN Political Declaration of 2011 recognises the role of NCDs in hampering progress towards the Millennium Development Goals and recognises the importance of healthy food and physical environments in addressing the global NCD crisis. Moreover, the subsequent Rio+ 20 Outcomes Document (2012) frames health as "a precondition, an outcome and an indicator of all three dimensions of sustainability"—i.e. environmental, economic and human development. Surely the lessons here for Africa cannot be ignored.

As plans for mass mechanised food production in Africa escalate, the golden pot (of adequate food and nutrition for all) at the end of the rainbow is tantalisingly close. Reaching it will indeed be cause for celebration. But the window for averting the disastrous unintended social and health effects of 'overnight' transition is closing rapidly and, once closed, will never be fully reversible.

Food security should not be the end game for developing nations. Rather it should be viewed as the essential substrate on which health, wellbeing, social cohesion, productivity and prosperity can be built and sustained. Let us not ignore the opportunity presented by lessons from the past for the developing nations of the world. Let us join disciplines and pool knowledge and expertise to demonstrate that rapid transition from food scarcity to food security can be achieved with minimal adverse social and health effects, through careful planning and an integrated, all-systems approach. ■

* Associate Professor Ruth Colagiuri and Dr Si Win Tin, Health and Sustainability Unit, Menzies Centre for Health Policy, The University of Sydney. The views expressed are those of Associate Professor Colagiuri and Dr Tin.

Dr Tony Fischer

PHOTO: NEIL LYON; FAIRFAX AGRICULTURAL MEDIA

"Three wise men who understand agriculture better than just about anyone have homed in on the critical questions and taken an unbiased look at the evidence."

—David Lobell, MacArthur Fellow (2014–18),
Stanford University, California, USA

FEEDING THE WORLD TO 2050—WILL YIELD INCREASES BE ENOUGH?

An effective way to advance food security and protect the environment is discussed in a groundbreaking text published by ACIAR.

Crop yields and global food security: will yield increase continue to feed the world? is an invaluable reference book by Dr Tony Fischer, Dr Derek Byerlee and Dr Greg Edmeades. The 640-page book is published by ACIAR, with funding support from the Grains Research and Development Corporation (GRDC).

Future yield prospects and influences behind crop area and yield change are considered in key breadbasket regions of the world. This analysis is conducted across a variety of important crops including wheat, rice, maize, soybeans and many others for the past 20 years.

The authors conclude that further, sustainable intensification of agriculture can produce

enough food to meet the demand for a growing world population to 2050. Achieving this will require a great effort and investment in agricultural research, development and extension, especially in the developing world.

"Increasing yield saves land, reduces prices and encourages trade, upon which a growing proportion of the world depends, while for those rural poor disconnected from trade, yield increase directly alleviates hunger and poverty," Dr Fischer said.

Dr Fischer is the former head of the wheat program at the International Maize and Wheat Improvement Center in Mexico. In Australia he headed ACIAR's soil and crops program, was a board member for the GRDC, and is an Honorary Researcher at CSIRO Plant Industry.

"We see special potential in Sub-Saharan Africa, where intensification has barely begun and there

is a large scope for closing the 'yield gap'—the difference between farmers' yields and those obtained in research stations," Dr Fischer said.

"In contrast, we've seen crop yield successes in areas such as Western Australia, one of the driest wheat regions with the poorest soils in the world, due to the widespread adoption of new agronomy, including conservation agriculture and direct seeding, earlier seeding, increased use of nitrogen fertiliser, better crop rotations and better yielding varieties.

"Boosting investment in agricultural research, development and extension, including new approaches such as genetic engineering, are essential for future yield growth, but so too are huge investments in better institutions, infrastructure and policy, especially in the developing world." ■



Crop yields and global food security: will yield increase continue to feed the world? was promoted and well received at the 2014 Borlaug Summit on 'Wheat for Food Security', in Mexico, and officially launched on 8 May 2014 at the annual conference of the Australian Institute of Agricultural Science and Technology in Brisbane.

The book (A\$85, incl. GST, plus postage) is available from the ACIAR website (<http://aciar.gov.au/publication/mn158>).



PHOTO: SARAH VANDERMARK

2014 John Dillon Fellows: (back, from left) Gideon Pama (National Fisheries Authority, Papua New Guinea), Dr Hassan Warriach (University of Veterinary and Animal Sciences, Lahore, Pakistan), with Mike Dillon and Patrick Dillon, Dr Yingjun Zhang (China Agricultural University, Beijing, China), Dr Hung Nguyen-Viet (Center for Public Health and Ecosystem Research, Hanoi, Vietnam); (front, from left) Dr Rina Laksmi Hendrati (Center for Forest Biotechnology and Tree Improvement, Yogyakarta, Indonesia), Matilda Hamago (Papua New Guinea Coffee Industry Corporation Ltd, Goroka, PNG), Dr Malavanh Chittavong (National University of Laos, Vientiane, Lao PDR), Dr Lilis Sadiyah (Research Center for Fisheries Management and Conservation, Jakarta, Indonesia) and Maria Lilia Vega (Visayas State University, Baybay City, Leyte, the Philippines).

PROFESSOR JOHN DILLON'S FAMILY CONNECTIONS

A group of ACIAR cyclists meets regularly for a morning brew on its way to work. The chosen location is a neat coffee 'pop-up' stall by the bike path. Recently, and to their enormous surprise, these intrepid ACIAR staff discovered that the engaging gentleman running the stall is Professor John Dillon's grandson, Patrick Dillon. Given this happy coincidence, the 2014 John Dillon Fellows were the first to meet the John Dillon family. On a beautiful early Canberra morning, the nine Fellows arrived at the stall and were introduced to Patrick and his father, Mike Dillon. On behalf of the fellows, Matilda Hamago, from the Papua New Guinea Coffee Industry Corporation, provided Mr Dillon with an appropriate gift of coffee, grown by PNG smallholder women farmers. ■

Visit the ACIAR YouTube channel (www.youtube.com/user/ACIARprojects) to view films on the John Dillon Fellowship.

SENATOR THE HON. BRETT MASON VISITS SAMOAN TARO INDUSTRY

It has taken a strong collaborative effort to support the recovery of the Samoan taro industry following the devastation caused by taro leaf blight. The success of this effort was showcased during a visit to Samoa by Australia's Parliamentary Secretary to the Minister for Foreign Affairs, Senator The Hon. Brett Mason, on 9 May. Senator Mason is pictured here with the Samoan Minister of Natural Resources and Environment, Fa'amoetaulua Dr Faale Tumulii. ■



PHOTO: DEPARTMENT OF FOREIGN AFFAIRS AND TRADE

Policy dialogue on rice futures

A policy forum on 'rice futures' coordinated by ACIAR in Phnom Penh, Cambodia, on 7 to 9 May marked the completion of a five-year program of rice-based farming systems research in the Mekong region. The event brought together researchers and policymakers to share their diverse knowledge, perspectives and experiences, and to develop a new policy dialogue and policy options for the future. Conference proceedings and other

outputs from the program will be released later in 2014.

The key messages were:

- The Mekong region is dealing with an oversupply of rice; however, farmers have opportunities for diversifying into other commodities to improve their livelihoods.
- Good opportunities exist in niche rice markets for Lao and Cambodian farmers.

- Diversification, mechanisation and engaging with the private sector are key factors underpinning continued improvement of livelihoods and wellbeing in the Mekong region. ■



VOLUNTEER PARTNERSHIPS

ACIAR and the Crawford Fund showcased our engagement with the Australian Volunteers for International Development program at an event in Canberra in March. Pictured are volunteers (from left) James Morschel, Adi Smith and Bonnie Flohr, returned from China, Vietnam and Tibet respectively. Ms Flohr worked on an ACIAR project in Tibet investigating ways of producing and storing fodder. She has been a graduate officer at ACIAR for the past 12 months. ■



PHOTO: CANBERRA TIMES

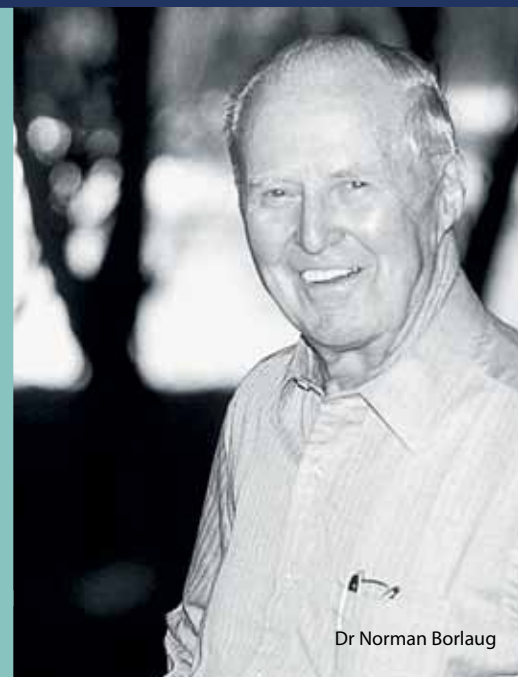


PHOTO: BRAD COLLIS

Dr Norman Borlaug

Borlaug 100

The Borlaug Summit on Wheat for Food Security took place in Mexico on 25 to 28 March 2014. Dr Eric Huttner, ACIAR's research program manager for crop improvement and management, attended this significant event. The summit included a celebration of the life and legacy of hunger fighter and crop-breeding pioneer Dr Norman Borlaug. The event brought together thought leaders and policymakers, along with public and private representatives of leading organisations in agricultural research for development.

NEW SOUTH WALES PARTNERSHIPS EVENT

On 18 March, the contribution to international agricultural research by New South Wales researchers and agencies was recognised at a Crawford Fund event at Parliament House in Sydney. The NSW Minister for Primary Industries, Katrina Hodgkinson, told approximately 100 attendees that this effort was "inspirational", and that the benefits of international collaboration in agricultural research were "wide-ranging and immense". ■



ACIAR in film

ACIAR's library of films is growing. Recent additions canvass the John Dillon Fellowships, the Lao fishways research project and the Pakistan dairy project. Three films on ACIAR research in Cambodia—on forage, vegetable and cropping systems—have also been produced and are available online.

Visit ACIAR's YouTube channel, which also features films made by our project partners: www.youtube.com/user/ACIARprojects



Filming *Food Bowl* in Timor Leste.

PHOTO: SARAH VANDERMARK

FOOD BOWL—SHARING ACIAR STORIES

An exciting new television program, *Food Bowl*, explores how agriculture, science and the art of farming are making a difference to communities across Asia. The first episode of *Food Bowl* was aired on Australia Network in April. Geographically anchored in Lao PDR, it features the people and research programs participating in two iconic ACIAR projects on

livestock (cattle) and forestry (teak), in addition to the local culture and scenic surrounds.

A similar approach to showcasing research partnerships, local culture and livelihoods is taken in two further episodes of *Food Bowl*. The exemplary, long-term 'Seeds of Life' program and the comparatively new ACIAR livestock program are profiled in *Food Bowl* in Timor Leste.

Papua New Guinea's New Ireland and East New Britain provinces present a spectacular backdrop for *Food Bowl* PNG. Here, ACIAR projects on mariculture, cultivating sea cucumbers, and on recovery of cocoa production following the devastation wrought by the cocoa pod borer are presented in the context of local communities and culture. ■



PHOTO: LIZ OGUTU

New Africa office

ACIAR and Canada's International Development Research Centre (IDRC) launched their new shared offices in Nairobi, Kenya, on 10 March. Pictured at the launch are (from left) Dr Simon Carter (IDRC regional director for Sub-Saharan Africa), His Excellency Geoffrey Tooth (Australian High Commissioner to Kenya), Jean Lebel (IDRC president), Dr Willy Mutunga (Chief Justice and president of the Supreme Court of Kenya), and His Excellency David Angell (Canadian High Commissioner).

NEW APPOINTMENTS

Dr Andrew Alford is research program manager, impact assessment. Andrew previously worked with Meat and Livestock Australia. He holds a Bachelor of Rural Science, a Master of Economics and a PhD in bioeconomic modelling.



Dr Robert Edis is research program manager, soil management and crop nutrition. Robert was previously an agricultural science consultant and Associate Dean of the Melbourne School of Land and Environment at the University of Melbourne.



Parnell Kennon is manager, procurement and contracting support. Parnell comes to ACIAR with a wealth of experience working in Australian government departments and agencies. He is completing a Master of Commerce with a focus on ethics and leadership.



Dr Ejaz Qureshi is research program manager, agricultural development policy. Ejaz has more than 15 years' experience dealing with natural resource management and associated policies, most recently with CSIRO. He has worked extensively in Australia, China, Pakistan, Indonesia and India.



Dr Sarah Vandermark is director of communications and stakeholder engagement. Sarah comes to ACIAR with a background in research and innovation policy and strategy, science communication, research and stakeholder engagement.



NEW ROLES

Dr Peter Horne is now general manager for country programs.

Dr Richard Markham is now research program manager for the horticulture program.

Ms Liz Ogutu has been appointed as ACIAR's African regional manager.

Ms Mellissa Wood is now general manager for global programs, along with her role as director of the Australian International Food Security Research Centre.

FAREWELLS

ACIAR has farewelled the following staff members: **Alexandra Bagnara** (social media manager), **Dr Les Baxter** (research program manager, horticulture), **Dr Simon Hearn** (principal adviser/ research program manager agricultural development policy), **Geoff Morris** (Vietnam country manager), **Warren Page** (communications manager), **Olivia Shanahan** (project support officer cropping systems & economics program) and **Samantha Williams** (communications officer).

NEW PUBLICATIONS

For details on ACIAR's scientific publications series and corporate publications please visit: <http://aciar.gov.au/publication/latest>

CORPORATE PUBLICATIONS

ACIAR Strategic Plan 2014–18

<http://aciar.gov.au/publication/cp027>

SCIENTIFIC PUBLICATIONS TECHNICAL REPORT



Developing a clean market chain for poultry products in Indonesia

I. Patrick, G. Smith, Hasnah, N.P. Sarini, H. Karim, B. Kurnianto, D. Dharma, A.A.S. Putri Komaladara and T. Jubb
TR 082

<http://aciar.gov.au/publication/tr082>

MONOGRAPHS



Crop yields and global food security: will yield increase continue to feed the world?

T. Fischer, D. Byerlee and G. Edmeades
MN 158

<http://aciar.gov.au/publication/mn158>



Tomato, capsicum, chilli and eggplant: a field guide for the identification of insect pests, beneficials, diseases and disorders in Australia and Cambodia

S. McDougall, A. Watson, B. Stodart, T. Napier, G. Kelly, D. Troidahl and L. Tesoriero
MN 157

<http://aciar.gov.au/publication/mn157>



Market fishes of Indonesia / Jenis-jenis ikan di Indonesia [bilingual publication: English / Indonesian]

W.T. White, P.R. Last, Dharmadi, R. Faizah, U. Chodrijah, B.I. Prisantoso, J.J. Pogonoski, M. Puckridge and S.J.M. Blaber
MN 155

<http://aciar.gov.au/publication/mn155>



Integrating herbaceous legumes into crop and livestock systems in eastern Indonesia [English and Indonesian translations]

J. Nulik, N. Dalgliesh, K. Cox and S. Gabb (eds)
MN 154 and 154a

<http://aciarc.gov.au/publication/mn154> and
<http://aciarc.gov.au/publication/mn154a>



Sandelwud blong Vanuatu: gaed blong planem sandelwud long Vanuatu [Bislama translation]

T. Page, H. Tate, J. Tungon, M. Tabi and P. Kamasteia
MN 151a

<http://aciarc.gov.au/publication/MN151a>



Nursery management of grouper: a best-practice manual [Indonesian translation]

S. Ismi, T. Sutarmat, N.A. Giri, M. A. Rimmer, R.M.J. Knuckey, A. C. Berding and K. Sugama
MN 150a

<http://aciarc.gov.au/publication/mn150a>



Hatchery management of tiger grouper (*Epinephelus fuscoguttatus*): a best-practice manual [Indonesian translation]

K. Sugama, M. A. Rimmer, S. Ismi, I.Koesharyani, K. Suwiry, N.A. Giri and V. R. Alava
MN 149a

<http://aciarc.gov.au/publication/mn149a>

PROCEEDINGS



Socioeconomic agricultural research in Papua New Guinea

G. Hickey (ed.)
PR 141

<http://aciarc.gov.au/publication/PR141>



Applying photosynthesis research to improvement of food crops

J. E. Gready, S. A. Dwyer and J. R. Evans (eds)
PR 140

<http://aciarc.gov.au/publication/PR140>



Smallholder HOPES—horticulture, people and soil

J. Oakeshott and D. Hall (eds)
PR 139

<http://aciarc.gov.au/publication/pr139>

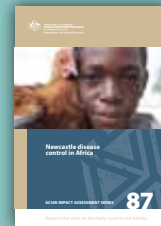


Cattle health, production and trade in Cambodia

J. Young, L. Rast, S. Sothoeun and P. Windsor (eds)
PR 138

<http://aciarc.gov.au/publication/pr138>

IMPACT ASSESSMENT SERIES



Newcastle disease control in Africa

H. Fisher
IAS 87

<http://aciarc.gov.au/publication/ias087>

Returns to ACIAR's investment in bilateral agricultural research

R. Lindner, P. McLeod and J. Mullen
IAS 86

<http://aciarc.gov.au/publication/IAS086>



ACIAR wheat and maize projects in Afghanistan

A. Jilani, D. Pearce and F. Bailo
IAS 85

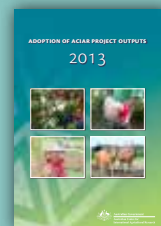
<http://aciarc.gov.au/publication/IAS085>

Impact evaluation of natural resource management research programs: a broader view

J. Mayne and E. Stern
IAS 84

<http://aciarc.gov.au/publication/ias084>

ADOPTION STUDIES



Adoption of ACIAR project outputs 2013

D. Pearce, A. Jilani and D. Templeton
AS 010

<http://aciarc.gov.au/publication/AS010>

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Often it is the younger family members who benefit most from access to improved food, nutrition and opportunity.

PHOTO: DAVID HERRIDGE

ACIAR'S VISION

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

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



ACIAR
aciar.gov.au

Front cover: Indigenous bitter melon (Muop dang) production in Phu Tho province by local farmer, Ha Thi Cuc.

PHOTO: PHAN THUY HIEN