PHOTO: BRAD COLLIS

Farming's resource base is being squeezed by competing land-use demands and urban spread.

ENVIRONMENTAL FARMING
the new agriculture

The challenges facing agricultural science are immense, but sustainability is achievable if scientists and producers can develop agriculture in a wider ecological framework

BY JOHN WILLIAMS & BRAD COLLIS*

The need for food production gains is as great today as when science delivered the famine-averting Green Revolution in the 1960s. Then, the answer was high-input farming sustained by higher-yielding seed varieties, better pest control and soil nutrition. Today, evidence is mounting that the productivity of many of these farming systems is again struggling to be sustained.

The new green revolution is facing a new set of challenges focused on the shrinking resource base. Agriculture's resource base—its land, water, nutrients, and its people—can no longer be derived from or function in isolation to the surrounding natural landscape.

This leaves agricultural science with perhaps its greatest challenge yet: to meet rising global demand for food, animal feed, fibre and fuel, when the production of these basics is being eroded by competing land use demands, soil degradation, water scarcity, pollution, pests and weeds pressure, climate change, and rising energy costs.

The achievements and merits of the Green Revolution are fading into history, even as many still naively assume we can continue to feed the world on the back of these historic successes. To the contrary, there is mounting evidence of an increasingly complex, food/environmental crisis in the decades ahead.

Previously the easy answer was to bring more land under cultivation to solve issues of population growth and market expansion. Today, the land itself is under threat; in many places disappearing completely beneath accelerating urban development. Added to this, almost two billion hectares and three billion people are struggling against high and increasing levels of land degradation. One way or the other we are losing land, and water, faster than we can find new areas to farm or new water resources to tap.

Pressure on food supplies is already driving agricultural expansion into unsuitable or inappropriate areas—regions of low arability or the forests, wetlands, peat lands, savannahs and grasslands that are crucial for biodiversity. The planet's ecological functions are being damaged at the very time they should be being repaired to help us meet climate change and the imperative for wide-scale carbon sequestration.

We are learning, slowly, that there is a limit to agriculture's resource base. For instance, at current rates of use, reserves of phosphorus—an essential component of up to half of all

fertilisers—may be depleted in as little as 50 years.

The unequal distribution of food and inevitable conflict over control of the world's dwindling natural resources present enormous political and social challenges to governments and policy makers. The mismatch is real and could have frightening consequences as the unstoppable forces of climate change and world population (projected to expand from 6.7 billion to 9.2 billion by 2050) meet.

HOLISTIC SOLUTIONS

How then do we achieve the seemingly unachievable? How do we increase agricultural productivity while protecting the natural assets that will sustain production long into the future?

The first step is to look at ecological, energy and water systems as a whole to understand the impacts, or the footprint, of food production on our natural resource base. This core message is finding advocates among international policy-setters, including the World Bank in its *2008 World Development Report: Agriculture for Development*, the 2008 report from the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), and the United Nations' Food and Agriculture Organization (FAO). All are pointing to the need for urgent change to secure the agricultural, ecological and scientific foundations that support food production.

Science and innovation that strengthens sustainability, while improving productivity and on-farm profits, is possible. Such systems have been developed in Australia and widely adopted by grain growers who are moving increasingly to conservation farming techniques, such as no-till farming—improved agronomy through more sophisticated crop rotations and integrated weed and pest management options that rely less on chemicals. These have all been in response to environmental stresses such as soil erosion, dryland salinity, more frequent drought and declining rainfall generally.

Much of the science behind these farming innovations is a consequence of Australia's capacity to invest expertise and excellence into agricultural research. ACIAR draws on this knowledge and expertise to help smallholder farmers in less developed countries who are struggling against similar environmental stresses and production constraints but do not have access to the same scientific muscle. In partnership with developing countries, ACIAR-supported scientists are exploring a wide range of soil–plant–water dynamics that improve our understanding of the many landscapes in which we farm and the diverse agro-ecological mosaics of crops and natural habitats.

A feature of ACIAR's approach is to view farming communities holistically, encompassing social, cultural, policy and economic factors that affect agriculture's performance. This systems and community-wide approach is particularly important when research projects straddle diverse land use and a diverse management of the resources that support crops, livestock, forestry and fisheries. The organisational systems and infrastructures needed to regulate food, feed and fuel production in this way are also being studied and improved.

Over the past 20 years ACIAR has earned international respect for its effectiveness in building research and extension alliances that deliver lasting benefits to the communities with which it engages. Through its in-country projects and its postgraduate scholarships it has always placed a high priority on capacity building. But as successful as this has been, ACIAR and its partners continue to face the need to increase the body of available expertise as demand increases for new answers, be they biological alternatives to fossil-fuel-based agrichemicals or the unrelenting need to keep plants and animals a step ahead of pests and diseases evolving their way around agriculture's defences.

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A new generation of geneticists and plant breeders must be attracted to the challenge, and be trained—and even then, all of their work will come to naught if the resource base is not secured.

All this requires new science and a new generation of agricultural scientists able to address the needs of the world's rural communities who, it is often forgotten, sustain all of humanity.

ACIAR'S SPECIAL ROLE

ACIAR exists to help communities develop more productive and sustainable agriculture where vulnerable farming systems and poverty are intrinsically linked. The emphasis is on building working partnerships at policy, research and extension levels—from international bodies, such as the 15 research centres of the Consultative Group of International Agricultural Research (CGIAR), through to in-country specialists and village communities. It is a successful, systems-wide approach that is making progress because it gives smallholder communities access to appropriate agricultural science and expertise.

One example is ACIAR's on-the-ground support for the growth and spread of Landcare in the Philippines. By changing the way farmers manage their sloping lands, income-earning 'crops' are being grown as hedges whose principal role is actually to stabilise soils and stop erosion (see report page 12). Three provinces in the Philippines now have extensive Landcare networks that are helping farmers to move from subsistence food production to crop surpluses that pay for healthcare, education and other living improvements.

This collaborative, research-driven approach is working as a proven model at a critical time when climate change is adding to the challenge of making farming systems more resilient and capable of actually affording to put in place environmental programs.

At the base of much of this work (be it breeding more climate-tolerant and pest and disease-resistant crops, or improving water and soil management) is the imperative of securing agriculture's resource base—the environment, landscapes and communities that sustain farming.

ACIAR's record of 'making a difference' is showing that it is possible to create stronger agricultural systems that contribute to healthy and productive landscapes. It is not easy, but it is essential.

However, the traditional scope of agricultural science may no longer be enough to achieve the required dual goals of secure food production and a healthy natural resource base. 'Agricultural science' needs to start encompassing a broader suite of disciplines that integrate agriculture into the social, environmental and economic variables that will shape farming's capacity to feed and clothe eight or nine billion people without exhausting agriculture's life-support systems. ■

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