



Food production under irrigation faces increasing competition for water as more water will need to be returned to damaged rivers and estuaries and climate change threatens declining snow and rainfall in river catchments. Photo: John Williams

Throw climate change and high energy prices into the mix and we have perhaps the greatest challenge ever to face agricultural science. Global agricultural production will need to be increased substantially to meet rising demand, but it must be achieved with a decreasing impact on the natural resources and environment at a time when the cost of energy will continue to rise.

In the past the answer was to bring more land under cultivation. However, the World Bank showed last year that the land frontier is closing in the more densely populated parts of the world. In other areas, pressure on food supplies is driving expansion into more marginal areas as well as rainforests, wetlands, peat lands, savannahs and grasslands, leading to further loss of biodiversity.

“GREEN REVOLUTION” FADING

In early June a summit convened by the UN Food and Agriculture Organization made a declaration calling for governments to do more to help the world’s smallholder farmers adapt to climate change. In particular, it declared support for “the establishment of agricultural systems and sustainable management practices that positively contribute to the mitigation of climate change and ecological balance”.

The relationship between climate change and agriculture is a two-way street. Factors such as changes in temperature, precipitation, carbon dioxide fertilisation <explain>, climate variability and surface water run-off will all affect productivity. Climate change is also predicted to affect the distribution of plants, invasive species, pests and disease vectors.

In the 1960s the solution proposed was for a “Green Revolution” based on

Farming without Harming

BY JOHN WILLIAMS AND FIONA MCKENZIE

Agriculture needs to find new ways to feed the world’s expanding population in an era of climate change, dwindling natural resources and rising energy and fertiliser prices.

Wheat, corn and rice prices have more than doubled in the past 2 years. Global cereal demand is projected to increase by 75% between 2000 and 2050, and global meat demand is expected to double. Global cereal reserves have fallen to their lowest levels for 30 years, and oil prices

have more than tripled since the start of 2004.

Food riots are not uncommon. Higher incomes, urbanisation, and changing preferences are raising domestic consumer demand for high-value products, shifting consumption from grains to meat and dairy.

high input systems sustained by a suite of new seed varieties, pesticides and fertilisers. But evidence is now mounting that the productivity of many of these systems cannot be sustained. Productivity is being undermined by pollution, salinisation, soil degradation and pest and weed build-up.

Today, almost two billion hectares and three billion people are affected by significant levels of land degradation, so the Green Revolution won't give us a get-out-of-jail free card. Surveys show we are losing land as quickly as we can find new areas to farm. Just when we need to magically increase productivity, the very land we rely on is under threat.

It is clear that the mounting crisis in food security is of a different complexity and potentially different magnitude than the one of the 1960s. There is a limit to the world's resources. At current rates of usage, phosphorus reserves may become depleted in as little as 50 years.

The price of fertiliser is going through the roof due to global demand as well as rising energy prices. Monoammonium and diammonium phosphate, two fertilisers of choice for Australian cereal crops, have recently hit \$1600 per tonne, more than double the price 12 months ago. "Round-up" herbicide has increased from \$4 per litre last October to \$13 today. Even the cost of tractor tyres is expected to rise as the costs of raw materials and production go up.

HOLISTIC S&T SOLUTIONS

The unequal distribution of food and conflict over control of the world's dwindling natural resources present a major political and social challenge to governments and policy-makers. This is likely to reach crisis status as climate change advances and world population expands from 6.7 billion to 9.2 billion by 2050.

How, then, do we achieve the seemingly unachievable? How do we increase agricultural productivity and yet protect the natural assets that will underpin



Sorghum established with minimum tillage and a trash blanket is an example of improved farming practice to cope with climate variability and improve soil health. Development like this is needed to increase food security and reduce damage to the environment. Photo: Matt McKenzie

production into the future?

For too long the emphasis of agricultural science has been on delivering technologies to increase farm-level productivity. Little attention has been paid to a more holistic integration of natural resource management with food and nutritional security. Fortunately there is increasing recognition that this current mode of operation requires revision.

We are beginning to realise that today, more than ever, we need science and technology systems that enhance sustainability while maintaining productivity. To do this we desperately need improved understanding of the landscapes in which we farm. We need to better appreciate soil-plant-water dynamics and the agro-ecological function of mosaics of crops and natural habitats.

Where we do get the science right,



Millet sown into native pasture, helps to integrate productivity with the ecological processes of the landscape. Photo: Matt McKenzie

organisational capacity and the right policies are still required or we take two steps forward and one step back. Governments need to adopt policies that create incentives for sustainable practices and internalise costs to the environment.

PRICING FOOD FOR SUSTAINABILITY

Traditionally, food prices do not include the cost of environmental damage, and the natural resource base continues to suffer. We can't afford to keep running down the systems that feed us.

Farmers will never be able to farm sustainably and profitably as long as the cost of maintaining and improving the natural resource base in agricultural systems is not included in the price of food. This may mean more expensive food, but it will also mean ensuring that we can continue to produce enough food.

We need market and trade policies that remove perverse subsidies. Rewarding the provision of ecosystem services is a good start. With a market for these services, farmers in the future will not only be paid for the goods they produce but also for the services they deliver through the management of healthy landscapes, rivers, wetlands and estuaries for the public good.

Agriculture, by its very nature, exploits the natural resource base. The nutrients in our food were once part of an ecosystem. It doesn't have to be an endless cycle of more and more synthetic inputs to offset ongoing land degradation.

The irony is that to break this endless cycle we need to create another. We need a system that has a closed loop that is resilient, that can cope with a certain amount of nutrient harvesting and yet stays healthy. Stepping off the treadmill is hard but it is necessary if we are to have both healthy and productive landscapes.

NEW CHALLENGES FOR SCIENCE AND ITS SUPPORT

Finding solutions to biophysical problems posed by agriculture are scientific



Global reserves of cereal crops, including barley, have fallen to their lowest levels for 30 years. Photo: Matt McKenzie

cally demanding. They require new ways of doing science within rural communities facing radical environmental, social and economic changes.

In an industry where inputs are increasingly expensive and climates continually variable, surviving is all about both precision and resilience, but there are serious deficiencies and problems with our scientific understanding of the rehabilitation process in many ecosystems and the environmental impacts of specific actions on the farm. We can't afford to keep ignoring the need for the research and development of farming systems that integrate productive land uses into the landscape in a way that is compatible with the ecological, hydrological and biogeochemical processes operating there.

Yet investments in publicly funded agricultural research and development in many industrialised countries has stalled or declined, and has become a small

proportion of total spending on science and technology.

Agriculture is not just about putting things in the ground and then harvesting them. It is increasingly about the social and environmental variables that will in large part determine the future capacity of agriculture to provide for eight or nine billion people in a manner that is sustainable.

It is possible to have both healthy and productive landscapes, but the present path of agricultural science is unlikely to achieve development goals for global food production and security while improving or at least maintaining the condition of the natural resource base and the global environment.

But there is a magnificent foundation on which to build and invest in the agricultural science needed to address these pressing issues. We need both reform of agricultural science and a significant increase in our national and international investment in new directions for agricultural science.

It doesn't make sense to spend public funds on research that the private sector can undertake profitably, such as developing novel seed varieties. In contrast, public investments in science that address environmental shortcomings with ramifications for society at large do.

Now is not the time for Australia to turn its back on the rest of the world and allow its investment and international commitment in agricultural science to



Agriculture is not just about putting things in the ground and harvesting them.

Photo: Matt McKenzie

decline further. This country has a tradition of leadership in agricultural science, and has much to contribute to this global problem.

The challenge of producing more food by farming without harming the natural resource base and environment in an era of increasingly expensive fertiliser, pesticides and energy coupled with the spectre of climate change is formidable. It is a wake-up call to our civilisation.

We must find ways to increase food production and not deliver a further period of damage to the natural resources and environment of the planet. But will we find ways so that both food and environment win?

John Williams is Commissioner of the NSW Natural Resources Commission, a Commissioner to The Australian Centre for International Agricultural Research and a member of the Wentworth Group of Concerned Scientists. Fiona McKenzie is a policy analyst with the Wentworth Group of Concerned Scientists. Information in this article is derived from published sources for which references are available at www.wentworthgroup.org.



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SECURING THE FOOD SUPPLY

World population is growing but environmental degradation is limiting our ability to increase food production. A world with more hunger will be a world with more war. Can science provide a secure, adequate and sustainable food supply, and if so how will it be achieved? *Issues* 69 examines possibly the most important topic of the 21st century.

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