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Our **Planet**

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AGRICULTURE AND ECONOMIC DEVELOPMENT

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THE WORLD BANK

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ACHIM STEINER
United Nations Under-Secretary-General and Executive Director, UNEP

By one measure at least, agriculture ranks as one of the extraordinary success stories of the past decades. Roughly one quarter of the Earth's terrestrial surface is now under cultivation with more land converted to crop production in the 30 years after 1950 than in the previous 150. In many regions - including Europe, North America, Australia and recently Brazil, China and India – humanity has also become adept at raising yields through using inputs like fertilizers and pesticides.

Yet in many poorer countries with low productivity rates and growing populations, agriculture continues to expand into marginal and fragile lands. In much of sub-Saharan Africa and large parts of Asia - according to estimates compiled by the Millennium Ecosystem Assessment (MA) – almost no highly productive land is left .

Assisting poorer countries to intensify their agriculture may seem the most obvious and sensible solution but intensification—at least under current models—carries significant stings in its tail. Unsustainable management of fertilizers, for example, contributes to a steady rise of oxygen depleted 'dead zones' in the world's seas and oceans and deleterious changes to inland waterways. Pesticide and herbicide use can contaminate freshwaters and – if inappropriately handled and stored - present serious risks to human health and the environment. And many monoculture crop systems have lost the ability naturally to combat diseases and pests making them ever more dependent on chemicals.

Some forms of intensification have aggravated disease. Recent outbreaks of foot and mouth in Europe and the arrival of 'mad cow' disease have had huge costs.Demand for food, and other agricultural products, will increase over the next decades as the world's population rises to an expected nine billion and people become wealthier. Yet climate change is likely to make meeting it more difficult. And some experts fear that, one of the measures taken to combat global warming - increasing the use of biofuels, made from grain, sugars and other crops - if carried out inappropriately, may increase food shortages among the world's two billion poorest people and put further pressure on forests and grasslands in some areas.
Increasing pressure on nature is not in the interests of farmers or the global community as a whole. For agriculture's very sustainability depends on such factors as water supply, soil fertility and stability and genetic resources from nature for improving crop strains— which are in turn provided by freshwaters, forests, biodiversity both above and below ground, and other healthy and productive ecosystems.

The MA, estimates that approximately 60 percent of ecosystem services– such as fresh water, capture fisheries, air and water regulation, and the regulation of regional climate, natural hazards and pests – are being degraded or used unsustainably. We must conserve and boost them, not reduce or further degrade them.

We urgently need to develop new sustainable models that balance ever more competing demands for food, fibres and fuels with our wider interests of maintaining the Earth's life support systems-a direction that is starting to emerge. It is against this backdrop that the United Nations, the World Bank, the Global Environment Facility and members of the private sector, scientists and civil society launched the International Assessment of Agricultural Science and Technology for Development, due to report in 2007.

We eagerly anticipate its findings and recommendations. The Assessment has – which has generously co-sponsored this issue of Our Planet, together with the Consultative Group on International Agricultural Research and the Agriculture and Rural Development Department of the World Bank – has been likened to the Intergovernmental Panel on Climate Change, which has been so important in encouraging nations to back the Kyoto Protocol and its flexible trading and other mechanisms. Similar creative ideas and inspiring market-led solutions are now urgently needed for agriculture. For a future based on business as usual will not bring in the harvest for the six billion people alive today, let alone the extra three billion to come ■

Seeds of **Hope**

LENNART BÅGE describes how grassroots agricultural research is increasing knowledge, innovation and productivity

Charlotte Thege/Still Pictures

Three quarters of the world's 1.1 billion extremely poor people live in rural areas and depend on agriculture for their survival. That's more than 800 million children, women and men – held back by lack of access to information, knowledge, land, water, financial services, and other assets essential to overcoming poverty.

Yet investments in agricultural research by and for poor rural farmers can increase income and food security – and do so sustainably. Spectacular returns can be achieved, as United Nations agencies discovered when they introduced Farmer Field Schools to Africa, helping to unleash a powerful movement that is enabling poor rural people to increase their income and food security.

These schools are small groups of farmers who conduct agricultural research to improve their productivity. Facilitated by researchers, extension workers or the farmers themselves, they build on their participants' traditional knowledge through hands-on, experiential research and learning in the field. Sixty per cent of participants are women.

First established in central Java in 1989 by the Food and Agriculture Organization of the United Nations (FAO) to fight a rice crop-destroying insect, the schools are now a huge success in East Africa, as well as in Asia.

The annual incomes of a sample of poor Kenyan farmers participating in the schools rose by at least 150 per cent. Average crop yields climbed by at least 20 per cent, and some farmers more than doubled them. The families of participating farmers in Uganda increased their food security.

These results are impressive, but even they do not show the most important effect: participants in Farmer Field Schools can become more independent and confident decision-makers – and leaders of their own development.

Five years after the schools were introduced to Africa – in programmes jointly funded by FAO and IFAD – 95 per cent of the original groups are still working together. Moreover, people who have graduated from them are participating in setting up Farmer Field School Networks – independent associations owned by farmers, governed by elected boards and financed by contributions from members.

Technical advances

The networks now support about 2,000 Farmer Field Schools in East Africa: nearly 50,000 people benefit directly. They organize research that focuses on their highest priorities and needs – commercial access to fertilizer, seeds and other inputs – and build profitable market chains for their products. Farmers are also using them to increase the flow of relevant information among the groups and speeding the transfer of innovations, indigenous knowledge and technical advances.

IFAD is testing ways to increase the networks' sustainability and marketing power. For example, the Linking Local Learners communication system, launched in 2004, uses the internet to bring the best of the face-to-face learning and knowledge generated in local groups to others far distant. The initiative has already demonstrated that improving the communication skills of farmers and their organizations helps them to overcome two major barriers to success: distrust among possible partners along the market chain and access to reliable market information. It is being scaled up and replicated in other African countries, and as far away as Peru.

Economic growth

The Farmer Field School movement thus shows that it is possible to generate very high returns on investment in agricultural research and rural development in Africa. This helps fulfil the agreement of global leaders at the 2005 United Nations World Summit that greater investment in agricultural and rural development is crucial for achieving the Millennium Development Goals. The leaders committed to increasing support for agricultural development and trade capacity-building in the agricultural sector in developing countries.

Agricultural development makes a critical contribution to overall economic growth in many developing countries. As farmers' incomes rise, so does their demand both for farm inputs and services, and for non-farm goods. Increased agricultural production also leads to increased demand for processing facilities.

Figures from the International Food Policy Research Institute show the multiplier effect of agricultural growth in Africa. Estimates range from an additional $0.60 in non-agricultural income in Niger for every $1 increase in farm income, to a near doubling effect in Burkina Faso of $1.88 in additional income outside the sector for every $1 increase in agricultural income. Agriculture in sub-Saharan Africa, indeed, generates at least 30 per cent of GDP, 40 per cent of exports and over 70 per cent of employment.

Rapid growth

Agricultural growth and development require investment and technology. With them huge productivity gains are possible. Over the past 20 years, increases in government spending on agriculture in East and South Asia have been clearly linked to rapid growth in agriculture and to progress towards achieving the Millennium Development Goals. In sub-Saharan Africa, however, public investment in agriculture is still far below what is needed, despite commitments by African governments to allocate 10 per cent of their public spending to it

Increased spending on agricultural research is vital, but it is equally important to ensure that the research carried out benefits the smallest farmers. In developing countries, it has all too often bypassed the most needy farmers, offering solutions that are beyond their reach or simply inappropriate to their livelihoods. The challenge is to develop technology in a way that is relevant to small farmers and to create the conditions they need to transform their small plots into viable small businesses that make a vital contribution to local and national economies. The Farmer Field Schools in East Africa show that when this is done, the results can be very impressive indeed ■

Lennart Båge is President of the International Fund for Agricultural Development (IFAD).

FAO

Pillars of Wisdom

LUÍS CARLOS GUEDES PINTO describes how agriculture must be based on the three pillars of economic feasibility, social fairness and environmental sustainability

Brazil is investing more and more in sustainable agriculture – harmonizing the exploitation of natural resources with preserving the environment – to make the best use of its huge agricultural potential. Around 28 per cent of its GDP derives from agribusiness, so it is crucial to direct this to competitiveness and sustainability.

Modern, efficient and competitive, agriculture in Brazil is a prosperous, safe and profitable activity. With a diverse climate, constant rain, abundant solar energy and natural resources, almost 13 per cent of the world's freshwater and a total area of more than 8,500,000 square kilometres, the country cultivates around 50 million hectares with annual crops and 20 million hectares with permanent ones and planted forests.

It also has about 220 million hectares of grazing ground. Converting this pasture offers great potential for increasing its farming, without prejudicing areas that need to be preserved. Brazil does not need to – and its agriculture policy does not intend to – extend agricultural production over new areas of native vegetation. Indeed, there has been a growing effort to preserve biological diversity: 61 million hectares of federal protected areas have been established.

An agricultural system can only be considered sustainable when it both satisfies producers' needs and preserves the natural resources for this generation and those that follow. Its development should rest on three pillars: economic feasibility, social fairness and environmental sustainability.

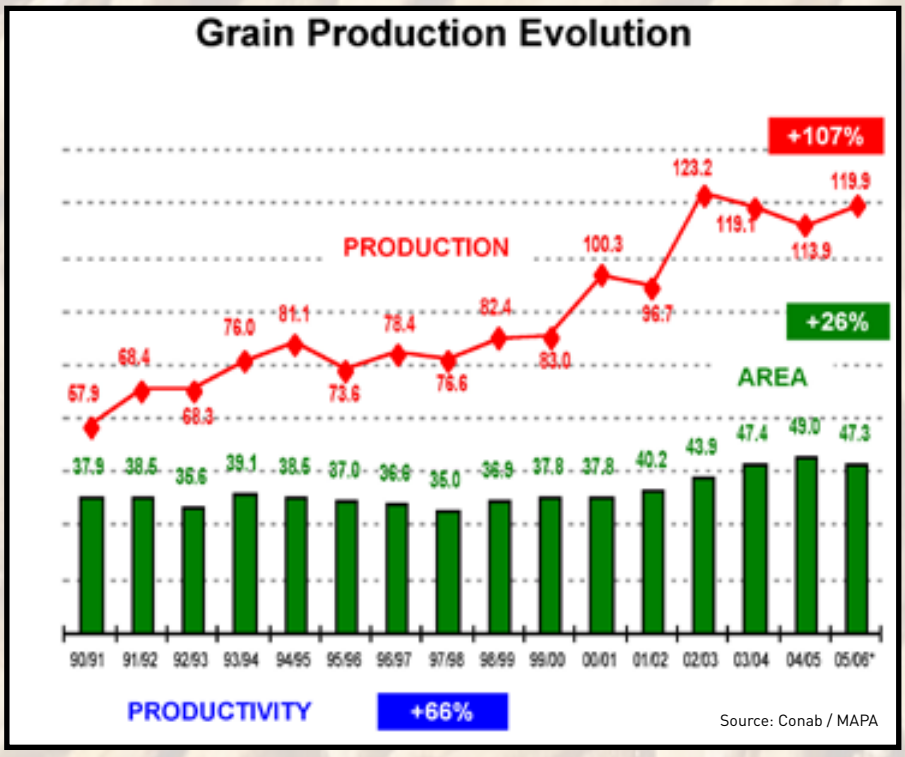
Brazilian agribusiness has substantially evolved in recent years. Total grain production has risen from about 58 million tons in the 1990/91 harvest to around 120 million tons in 2005/06, mainly through productivity gains. Over this period, the cultivated area grew by just 26 per cent, while production increased 107 per cent. (see figure).

The Cerrado is the country's second largest biome, occupying about 204 million hectares, 24 per cent of the country. It boasts about 5 per cent of the planet's biodiversity, with at least 6,500 species of wood flora and 11 natural landscapes. Land suitable for agriculture covers some 139 million hectares of it: 61 million hectares are occupied by cultivated pastures, 14 million grow grain, and 3.5 million have permanent crops.

It is an important producer of food, both for home consumption and for exports – contributing about 81 per cent of the country's sorghum, about 60 per cent of its soya, about 59 per cent of its coffee, about 55 per cent of its meat, about 45 per cent of its beans, about 44 per cent of its corn, and about 10 per cent of its sugar cane.

The Government, official research institutions, producers, and non-governmental organizations have joined in a continuous collective effort to ensure that sustainable production models are adopted in the Cerrado and other productive areas of the country, searching for systems that combine high productivity with environmental preservation and social and economic development.

The Direct Plantation System – one important sustainable production model adopted – constitutes a highly significant change in Brazilian farming and livestock. Planting takes place on minimally tilled soil, covered with straw from the previous



Source: IBGE e IBAMA.

harvest. This avoids erosion and saves inputs, like watering. It also spares equipment and machines, protects the soil, cuts expenditure on fuel and promotes carbon sequestration. Almost half the country's planted land now uses it.

Another model adopted in Brazil – called Farming-Livestock-Forestry – sets new technological standards for agriculture and livestock and allows damaged pastoral and cultivated areas with sustainability problems to recover. It involves grains, fiber, meat, milk, energy, and other crops in simultaneous, sequential and rotational cropping and aims at maximum exploitation of the biological cycles of plants and animals, of the residual effects of nutrients and of synergy among different activities.

Organic production is also being widely expanded throughout the country, attempting to copy and reproduce natural processes and to manage land and other natural resources in a balanced way. It achieves long term conservation and maintains harmony both among the elements of nature and with human beings. More than 6.5 million hectares of Brazil are farmed organically or subject to sustainable extraction; they reach high levels both of productivity and of quality in grains, fruits, green vegetable, coffee, sugar, fish, meat, milk, honey, and other products. There are some 20,000 organic producers, more than 80 per cent of them small ones. Thus organic agriculture promotes sustainable rural development.

Brazil is also a world leader in producing clean energy. Around 43.9 per cent of its total energy has its origins in renewable sources, a remarkable proportion for an industrialized economy. Sugar cane alone provides 13.9 per cent of the total energy consumed in the country. In 2005, the national ethanol programme generated approximately 180,000 barrels of gasoline per day, saving 24 million tons of carbon dioxide emissions in the year.

Two years earlier Brazil started to produce flexifuel automobiles, which – without modification – can burn any proportion of ethanol or gasoline. In 2005 it produced 906,366 flexifuel or alcohol vehicles, 35.8 per cent of total car output, and the proportion is rising. Between January to June 2006, they made up a majority (50.2 per cent) of the cars produced, amounting to 653,183 vehicles.

In December 2004, the Brazilian Government launched the National Programme of Production and Consumption of Biofuels, to reduce vehicles' emissions of global warming gases, decrease oil deficits, create jobs, and increase the income of smaller producers. Growing the raw material and producing industrial biofuels has great potential for generating jobs and thus promoting social inclusion, especially considering the high productive potential of family agriculture. Government investment in the research and development of biofuels may amount to 355 million Reais between 2006 and 2008

In October 2005, the National Agroenergy Plan – drawn up by Ministry of Agriculture and Supply with the support of the Brazilian Company of Farming and Livestock – came into force. It will create the basis for the Agroenergy Brazilian Consortium, which will bring together agencies from the Government and private companies, and be an investment fund. It will concentrate on production and research on ethanol agroenergy, biofuel, biogas, energy forests, and the use of waste.

Trade policy presents another huge challenge to Brazil. The Government is aware of the need to work intensively to overcome the protectionism of certain countries that raise difficulties for the access of Brazilian products to their markets. Products with a higher aggregated value than grains – such as vegetable oils, meats and dairy products – are discouraged with high tariffs (sometimes over 100 per cent), safeguards, subsidies, and other non-tariff barriers. These hinder the diversification of Brazilian exports, and thus of production. Without them, we would have greater possibilities for developing more diversified and environmentally friendly agribusiness. So if the planet's well-being depends on environmental quality – which is unquestionable – the responsibilities of each country in promoting sustainable development must be discussed and defined, considering all the implications ■

Luís Carlos Guedes Pinto is State Minister of Agriculture and Supply, Brazil.

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More Crop *Per Drop*

MARGARET CATLEY-CARLSON examines the absurdities of waste in a world of scarcity and explains that, as water cannot be created, it must be managed properly

There is enough water for all our purposes if it is managed properly". Most people in the world of water accept the truth of this statement. But it offers scant comfort to the woman walking to the distant well, to the farmer at the end of the irrigation canal, or to the urban slum dweller having to pay several times as much as a richer citizen for an insufficient drinking water supply. For them – and for the 28 per cent of freshwater fish in danger of extinction, for fields parched by recurring drought and for lakes diminishing year by year – water scarcity is a fact.

Such scarcity is likely to increase. We, the world's people, are probably already drawing down more than half of the one per cent of global water that is actually accessible to us – fresh, liquid and near to human habitation. We are experiencing the highest temperatures of the last two centuries, affecting rainfall patterns and the glaciers and snow that feed rivers. And we will add another 2.5 billion people – increasing our numbers by a third – before global population levels off. The combination of population growth, pollution, temperature variation, and increasing per capita use, ensures that close to half a billion people in 29 countries already face water shortages. By 2025, fully a third of the expected world population will be in regions facing severe water scarcity.

Intense competition

We are not really running out of drinking water. Globally we use just seven to nine per cent of water for drinking, and can divert more to this purpose. But, again, this is scarcely comforting to those who live where investments have not been made in water infrastructure, or where the existing infrastructure, delivery systems or social organization ignores the poor.

Competition is becoming intense, however, for water for economic purposes: growing food, fiber and now energy crops; industry; energy production; tourism. Poor people's needs for drinking water compete with these economic uses in developing countries and when water competition gets heavy, the environment almost always suffers. Investment decisions increasingly depend on water availability, and the quality and dependability of the delivery of water services. So how will economic development take place within this particular vicious circle?

Part of the answer lies in improving the use and efficiency of the 65-90 per cent of water used in agriculture. We need both more crop per drop; and more job per drop. Improved irrigation is important, as is new science and technology. But it is difficult to imagine major change without alterations in the incentive systems that govern the use of water on the farm. Saving agricultural water is also about choice of crop, choice of seed, and choice of farming methods. Billions of dollars are spent in subsidies to farmers without much consideration to the availability of water.

The road to truly sound and sustainable solutions probably passes via the needed long term overhauls of how agriculture is subsidized, the way water for industry or agricultural input is priced, and the extent to which local authorities are given the responsibility and capability to provide water to their people. Technology helps, but cannot solve the problem. And whether in the field or in the city, water scarcity is as much about the adequacy of financial resources, as of water resources.

Alternative method

Absurdities need to be fixed: major conurbations losing over forty per cent of their water to leaking pipes and faulty systems; whole cities where only a few get water bills, and less pay them, so there are no funds to afford repairs and extensions to pipes and systems – let alone to subsidize the water needs of the poor. There are countries with burgeoning populations and almost no water storage capacity. Some irrigation systems waste as much as 70 per cent of their water. Extensive, expensive, disruptive ▶

Julio Etchart / Still Pictures

infrastructure investments are made, with no attempt to conserve water or find alternative methods. Fossil water is used for cereal crops. India and China alone pump about two Niles-worth of water from underground sources, far more than rainfall can replenish: often both the water, and the electricity that powers the pumps, are free.

These may be absurdities but the remedies are not simple, not at all. Moving to a conscious, transparent, publicly announced allocation of available water is a fraught process, almost guaranteed to generate more enemies than friends. Moving towards charging for water services offers opposition politicians an instant election issue. There are taboos against the re-use of wastewater. Cleaning out corrupt or inept water administrations raises huge political problems. Inviting the private sector to help can provoke demonstrations and church-basement fundraising to prevent the 'commodification' of water. It is not easy to manage across boundaries, and to agree to share the benefits of water between neighbours with centuries-old traditions of mistrust.

Public opinion

It is too easy to call for political will – that scarce and much invoked commodity. Instead it must be created. This must be the top priority for all of us. But what are we doing? Experts redefine the problems. Aid donor nations spend little on water, and work independently. We sponsor and attend expensive global meetings that repeat the "we shoulds" over and over again, to the detriment of serious decisions about new forms of concerted action. Some countries make progress, many do not. Water is local, quintessentially so – unlike energy or food which travel through trade. If we do not begin to focus on the barriers and constraints to progress within countries, and on what it will take to overcome them, the situation will only worsen.

"If I gave you all the money you need to fix the drying Colorado River what would you do?", I asked two friends – one Mexican, one West Coast United States – last month. There was a long silence, a very long silence. Then both spoke at once. "It really isn't about money. We need to change the way people think about the water. We don't have the public climate of thought to make the right decisions." If we work mostly on hydrology and on reiterating the "we shoulds", who will do the real work to change public opinion?

Decision making

The Global Water Partnership (GWP), which I chair, this year celebrates its tenth anniversary. We provide knowledge about how water should be managed, and advice – through publications, our ToolBox, and events – on how to bring better practice. We are also a global support network for those working within countries and regions to change water resource use, and promote better management. We try within GWP, and within countries, to bring together cross sections of the concerned parties from academia, associations, national and local government, civil society, and water users and deliverers. We talk together about the issues that need to addressed, applying a cross sectoral, integrated approach that values and conserves water. We organize public consultations and help with the process by which some countries are thinking about solving problems and drawing up strategies for integrated water resource management. We do a little – but not enough – about creating public awareness and political will. Ten years brings satisfaction with the changes we have provoked, but also serious doubt as to whether the pace of change is sufficient to meet the one at which problems grow.

There is debate on whether there is in fact 'enough water to go around' but none on the fact that the greatest potential improvement in its availability would come through managing it better. Water cannot be created: it can only be managed. If by common consent, there is enough water – just enough in many areas, but probably enough – we have to set ourselves the task of improving management. This means getting into difficult, thorny areas of national and municipal decision making. There are answers that require patient cumulative change, but no silver bullets. There are difficult times on the horizon. But water is life – and life itself is at stake ■

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Doubly Green

Revolution

FRANCISCO REIFSCHNEIDER describes how agricultural research on natural resource management has furthered environmentally sustainable development

Mark Edwards/Still Pictures

Despite the doomsday predictions of the 1960s, global agriculture has largely succeeded in satisfying world demand for more food over the last several decades. Yet advances in productivity have clearly come at the cost of substantial damage to the natural resources on which agriculture and human livelihoods depend. This is particularly worrying, since global food demand is expected at least to double in the next 50 years, requiring agriculture to perform remarkable new feats of research-based growth in productivity.

The Consultative Group on International Agricultural Research (CGIAR) is conscious of the need to achieve environmentally sustainable development, and has taken decisive steps toward it. During the early 1990s, the mainly crop-oriented centres it supports significantly broadened their research agendas, placing stronger emphasis on natural resource management – and it created a series of programmes aimed at coordinating this work across them. It also began supporting four additional centres focussing exclusively on natural resource management. Thus, it assembled the main elements of a programme encompassing biodiversity, soils, water, fisheries, and forests. It is proving to be a powerful instrument for fostering what agricultural scientist Gordon Conway has called a 'doubly green revolution'.

Natural resources

Research on natural resource management accounts for about a fifth of the CGIAR's total budget, which has steadily increased since the early 1990s. Though the share spent on crop improvement has declined, it has continued to generate massive economic benefits through higher agricultural productivity, as documented in hundreds of studies.

Has research on natural resource management turned out to be an equally good use of scarce resources? A report completed recently by the CGIAR's Science Council answers positively. Its centerpiece is a diverse set of peer-reviewed case studies on research projects carried out by seven centres – and on one integrated initiative working across them. Five of the centre studies examine 'micro'-level research whose products – new technologies, knowledge or methods – have helped improve agricultural productivity in specific environments, while enhancing natural resources. The other two deal with 'macro'-level interventions – such as advice, information and tools – which shape the formulation of policies and standards for natural resource management. The impact of this research has an international reach, affecting many people who derive their livelihoods from natural resources.

The impact of the micro studies was evaluated using a neoclassical economics framework, much like that employed in many studies on the impact of crop improvement research. The following are brief summaries of selected cases:

■ In response to a notable slowdown of productivity growth in the vital rice-wheat systems of South Asia, CGIAR scientists joined forces with national partners, helping them design on-farm experiments to refine and promote such resource-conserving technologies as 'zero-till'. Their widespread adoption resulted in higher crop yields, lower production costs and savings in water and energy. The gains accruing to consumers and farmers were estimated at $94 million, compared to research costs of just $3.5 million.

■ Across West Asia and North Africa, CGIAR scientists and their national collaborators have developed integrated crop-livestock systems for dry areas, which farmers are gradually ▶

adopting. Cactus 'alley cropping', for example, has spread at a rate of 6 per cent a year in Morocco since 1999. It reduces soil erosion and mitigates the effects of drought on livestock production by improving and stabilizing feed supplies, lowering farmers' costs, on average, by 33 per cent.

■ In Southern Africa, CGIAR scientists have worked with partners since the early 1990s in to develop 'fertilizer tree fallows', which rely on locally available resources to enhance soil fertility. Within a decade, tens of thousands of farmers lacking access to chemical fertilizers had adopted them and found them to be profitable. A key benefit has been improved food security, estimated at 57 to 114 extra person-days of maize consumption per household.

Assessing the macro research required a different approach. It involved identifying and describing the demand for institutional or policy-related information, to which the research responded. The results of interviews, surveys, and other techniques indicated the degree to which demand was met. Though the case studies did not quantify the eventual economic benefits of information resulting from the research, it did chart plausible 'impact pathways'.

Future projections

CGIAR-supported research on forestry, for example, has generated a rich collection of information and knowledge that provides conservationists and others with better means of monitoring forest management and of certifying whether it is sustainable in particular cases. More than 80 per cent (some 37 million hectares) of the total forest area certified so far has been certified by companies that acknowledge using CGIAR products. It is reasonable to assume this has resulted in better forest management, contributing to more sustainable livelihoods for forest dwellers, but it is not easy to quantify the benefits and determine what share of them should be attributed to the CGIAR.

The two macro studies demonstrate that the CGIAR is responding effectively to global demand for tools and information that can guide critical decisions about natural resource management. Perhaps more to the point, the micro studies report respectable internal rates of return, ranging from 12 to 57 per cent, with benefits significantly exceeding costs and fully justifying the investment in research.

Although, as the Science Council report notes, these rates do not fall at the high end of the range reported for crop improvement research in many studies, they are still impressive. The five micro studies used conventional economic models that combine documented results with future projections but do not fully take into account the expected environmental benefits of the research. Yet, despite this limitation, all five projects proved to be sound investments, with results on a par with those of many studies assessing the impact of crop improvement research.

This outcome is all the more impressive considering that – while delivery systems for improved crop varieties have been in place for decades in developing countries – channels are only now being opened effectively to convey results from research on natural resource management. These results tend to

Mark Edwards/Still Pictures

be knowledge-intensive and are therefore difficult to share on a large scale. Accomplishing this has required unprecedented efforts to build effective partnerships with a wide array of government, civil society and private organizations from the local to global levels.

As researchers come to grips with the methodological challenges of assessing the impact of research on natural resource management, they will be able to cite more examples and deliver better results that truly reflect the unique character of this work. The centres supported by the CGIAR are already taking important steps towards that end, and an emerging network of scientists in them is developing, applying and sharing more effective impact assessment methods. A methodological guide will be prepared to support their work.

In the meantime, the case studies reported here – to be published by CAB International in a book that will also include a summary report by the Science Council – mark an important beginning toward comprehensive and ongoing assessment of the impacts of CGIAR-supported research on natural resource management. They also provide plenty of encouragement for this research to continue ■

Francisco Reifschneider is Director of the Consultative Group on International Agricultural Research (www.cgiar.org).

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The Growing *Business*

MANDIVAMBA RUKUNI explains that healthy agriculture is vital for sustainable development

The history of the world provides overwhelming global evidence that general economic growth of any nation must be preceded, or at least accompanied by, solid agricultural growth. Agriculture has played this central role since the English Agricultural Revolution which paved the way for the Industrial Revolution. This process still applies today, and poor countries in Africa, Asia and South America will be no exception. It is unlikely therefore, that any nation will be able to jump this vital stage of development.

As the economy of a nation develops, the role of agriculture will evolve. It will, however, continue to be important at every stage in a society; as it is for both rich and poor nations. In developing ones it is almost always the foundation and backbone of the economy since most people rely on it for food and employment. In the richer industrialized ones, the quality of life depends on the forms of agriculture in practice, in terms of health and nutrition, clean air and water, and the protection of nature. When we think of sustainable development, the agricultural sector of any economy is viewed broadly to encompass the associated aspects of food, farming and natural resources management.

Agriculture plays several traditional roles essential in overall economic growth. They include:

- Providing adequate and affordable food for increasing populations. The process of industrialization and urbanization is more efficient when food is more affordable for the growing industrial labour force.
- Supplying raw materials to growing and diversifying domestic industrial sectors. This is more crucial at earlier stages of industrial development, but it is still important, if less visible, even for industrialized nations.
- Releasing labour for the growing industrial sector. The ideal is to have as much rural employment as possible at lower stages of industrialization. As an economy industrializes, the countryside can efficiently release more labour to urban-industrial ▶

complexes. Ideally these migrants are better prepared for urban-industrial living if first equipped with some life and business skills.

• Enlarging the size of an effective market for the products of the domestic industrial sector. Since it takes time for the urban-industrial sector efficiently to absorb the rural labour, agriculture has to continue to thrive. The more disposable income available to rural households, the greater the demand for manufactured goods and services for the growing economy.

• Providing employment and livelihoods, and alleviating poverty, for a large percentage of the rural population. Evidence shows that it is as important to create rural jobs as urban ones in poor nations. Rural jobs are vital to slow down premature urban migration, propelled by rural poverty and lack of economic opportunity.

• Earning and saving foreign exchange. This is one of agriculture's most important roles in developing countries. As demand for imported goods and services rises, agriculture is often critical for the balance of payments, both through its exports, and through innovations that allow nations profitably and efficiently to grow substitutes for imports.

• Accumulating domestic savings for investment and capital formation. The more prosperous the agricultural and rural sector, the more people can save money, paving the way for a thriving banking sector that can finance further industrial development without relying unnecessarily on foreign debt.

Major issue

In his 1998 article, The Agricultural Transformation, C.P Timmer provides a conceptual framework for agricultural and economic transformation which shows four stages towards sustainable development. In the first stage, agriculture has been adequately nurtured and starts growing and creating new wealth at a rate that allows direct and indirect taxation, feeding into other major public assets and infrastructure. In the second stage, agricultural growth becomes a direct contributor to overall economic growth through greater links with industry, improving efficiency of product and factor markets, and continued mobilization of rural resources. In the third stage, agriculture is fully integrated into the market economy; prices of food and its share in urban budgets continue to decline. In the fourth stage agriculture is part of an industrial economy: its productivity and efficiency is a major issue, and environmental and other concerns assume greater significance.

As agriculture goes through these stages, its share in national accounts diminishes, and the population becomes more urbanized. Some poor developing countries, however, have misinterpreted this phenomenon, and prematurely diminished investment in agriculture. In industrial economies agriculture is politically alive even where farmers and rural people represent only two to three per cent of the population, they still command the attention of governments. Yet in developing countries, agriculture does not command as much political attention, even though more than half of their peoples live in rural areas.

Premature migration of large numbers of rural people into urban areas is unfortunate. Most have no jobs or housing to go to and most do not possess the life and economic skills to be gainfully employed in urban areas. Urban poverty and decay increase as over-stretched infrastructure breeds ill health, crime and breakdown of family structures. Moreover, it is largely young adults that migrate, draining rural areas of the energetic and creative force that is desperately needed to develop agriculture. Thus a premature shift in public investment priorities from rural to urban areas has not led to sustainable development.

Capital investments

Getting agriculture moving in developing countries is therefore an important step towards sustainable development. But it takes more than ideology to achieve this. Five basic prime movers require investment, development and coordination:

1. New technology produced by public and private investments in agricultural research, or imported from the global research system and adapted to local conditions.
2. Human capital in the form of professional, managerial and technical skills produced by investments in schools, agricultural colleges, faculties or agriculture and on-the-job training and experience.
3. Sustained growth of biological capital – such as by genetic and husbandry improvements of crops, livestock and forests – and physical capital investments in dams, irrigation, roads, grain storage, etc.
4. Improvements in the performance of institutions such as in marketing, credit, research, extension, and settlement.
5. Favourable economic policy environment and political support for agriculture over the long haul.

Worldwide experience has shown that no single prime mover, such as new technology or higher prices, can by itself increase agricultural production and sustain it over time. The challenge is to mobilize public and private investments in all five as a policy package over a period of decades ■

Mandivamba Rukuni is Regional Director for Africa Programmes at the W. K. Kellogg Foundation, Pretoria, South Africa.

Fish

Boom

MERYL J. WILLIAMS describes how aquaculture is boosting the world's fish harvest, growing food and creating value, but cautions that natural fish stocks are still critical for future fish supply

The word 'fish' conjures up a myriad of images – even conflicting opinions – around the world. Most experts agree, however, that we will not have enough fish to meet future demand unless we act now. Just when health authorities are recommending it as a good source of protein and the right fats, all the signs suggest that many of the world's natural stocks have been over-exploited, some seriously so, and that few frontiers remain. The 2003 groundbreaking report, Fish to 2020 from the Consultative Group on International Agricultural Research (CGIAR) concluded that the amount of fish the world can produce will greatly depend on how fast aquaculture develops. It also depends, of course, on whether natural fish stocks hold up or collapse.

Fish is a more important source of animal protein in Asia, Africa, the Caribbean, and the Pacific island countries – where the majority of the world's poor live – than in Europe and North America. It used to be called "the poor person's protein". Keeping fish available to the poor means ensuring it remains affordable – a challenge that can be met by farming the right fish. Fortunately, low-cost fish do not mean low-quality food: indeed, the modern aquaculture revolution in Asia is based on low-priced and highly nutritious freshwater carp and tilapia. About half of the continent's total aquaculture production comes from these species, and most is consumed domestically. The boom in carp and tilapia production has kept the price of fish within reach of the poor in the main producing countries, such as China, India, Bangladesh, the Philippines, Indonesia, Vietnam, and Thailand.

Low-cost fish do not mean low-quality food: indeed, the modern aquaculture revolution in Asia is based on low-priced and highly nutritious freshwater carp and tilapia. About half of the continent's total aquaculture production comes from these species, and most is consumed domestically

Mark Edwards/Still Pictures

Fish researchers have contributed to this boom in many ways. One programme stands out in particular because it demonstrates the power of a sound scientific approach and heeds lessons learned by agricultural colleagues. It involved breeding improved strains to make farming of carp and tilapia more efficient, and to keep down the price of fish. In a sustained effort dating back to the mid-1980s, the CGIAR-supported World Fish Centre and research partners in Africa, Asia and Norway applied rigorous selective breeding to create the GIFT (Genetically Improved Farmed Tilapia) fish.

More affordable

A major review of the GIFT work, carried out by the Asian Development Bank, found that the breed and its derivatives make up 68 per cent of tilapia seed in the Philippines and 46 per cent in Thailand, and its share is increasing in these and other important tilapia-producing countries. In the Philippines, tilapia is now more affordable than chicken and pork, and its price has fallen below that of the typical marine fish eaten by the poor: the galunggong or round scad. CGIAR 's work has also spurred investment in tilapia aquaculture and other research, leading to growth in tilapia exports by countries such as Vietnam, creating both food for people and value for Asian fish farmers.

Following Asian successes, tilapia farming in Africa has also begun to improve, thanks to CGIAR research, capacity building and a long-term commitment ▶

to using science to help more people become fish farmers. This support has focused both on small-scale farms in sub-Saharan Africa and larger scale ones feeding the people of the Nile Delta. Surprisingly, tilapia farming is also proving successful in the remote highlands of Papua New Guinea, where an Australian Centre for International Agricultural Research partnership project on hatchery and farm technology is helping iron out technical constraints to its growth, improving food options for highlanders.

In 1995, another CGIAR report, From Hunting to Farming Fish, suggested that within 15 years 40 per cent of the fish we eat would come from aquaculture. At that time, it only accounted for 22 per cent, so the projection was considered somewhat optimistic. Yet, in September 2006, the Food and Agriculture Organization (FAO) announced that 43 per cent of fish eaten were farmed.

Does this mean that we no longer need be so concerned about natural fish stocks? No. The Fish to 2020 projections showed that their collapse undermined even good aquaculture growth and pushed prices upward. Unless production from them is maintained, hundreds of millions of poor people will not be able to afford fish.

Valuable lessons

Fisheries scientists around the world have usually been the first to alert their countries to the dire state of stocks and to the causes of decline. But most action to halt the decline – mainly due to overfishing – has been unsuccessful. Scientists are leading efforts to improve fisheries management, using comprehensive approaches that integrate insights from economists, sociologists, biologists, and other specialists and working with stakeholders in real-world situations to understand and test them. Scientists from North and South alike are in the vanguard, working with local fishing families, government officers and nongovernment workers around small bodies of water in Bangladesh, on coral reefs in the Philippines, in Sri Lankan reservoirs, and along the rivers of Cameroon.

Recent research has produced many valuable lessons and findings. Scientists have established, for example, that the little-publicized fisheries of the developing world are just as depleted by overfishing as the more famous Newfoundland cod and North Sea ones. In addressing this problem, the concept of ecosystem-based fisheries management has emerged as a means of examining all components of fisheries resources and their supporting aquatic environments.

Barely visible

Other lessons concern the complexity and value of people's rights to use and own fish resources and show how compliance with rules is affected by their legitimacy and by the costs of non-compliance. Research has further demonstrated how power relations rule the conduct of business, so that powerful fishing enterprise owners can make good profits even in degraded fisheries, while their workers are held in poverty by low wages and high credit burdens. Another concern is that fishers and their families suffer high health risks (from HIV/AIDS, for example) which are not being addressed by mainstream health services. Research has also highlighted the importance of looking at fisheries development through a gender lens: women and children, often barely visible during the catching of fish, may play central roles in the services and postharvest sectors.

While confronting such challenges on the ground, researchers have worked in international fora to codify these carefully documented and analysed lessons in the FAO Code of Conduct for Responsible Fishing and its associated plans of action. This was endorsed in the 2002 Plan of Implementation of the World Summit for Sustainable Development and used to develop such strategies as the World Bank's 2004 Fisheries Sector Approach Paper "Saving Fish and Fishers".

Like all human activity, including agriculture, both fisheries and aquaculture place burdens on the environment they rely on. Science has contributed to identifying these burdens – such as coastal water pollution and fish disease from intense stocking and feeding – and to creating the solutions, like better feeds and reliable, evidence-based estimates of sustainable fish stocking density. Conservationists, scientists and fish farmers have created innovative partnerships to tackle these sorts of issues. Recently, the World Bank, WWF, the Network of Aquaculture Centres in Asia, FAO, and the United Nations Environment Programme (UNEP) released guidelines for environmentally sustainable shrimp farming.

Over the last decade, I have observed and experienced a transformation in fish research. We once worked mainly with fish "hunting and farming". But now, thanks to a better understanding of the global situation – achieved by researchers such as those supported by the CGIAR and ACIAR – we picture ourselves as helping the poor to grow food and create value in their lives from fish ■

Meryl J. Williams is Chair of the FAO Advisory Committee on Fisheries Research, and of the Board of Management, Australian Centre for International Agricultural Research. She is also a member of the Scientific Steering Committee of the Census of Marine Life. The article expresses her personal views.

Understanding the future

ROBERT T. WATSON, HANS HERREN AND JUDI WAKHUNGU describe an international assessment which will help decisionmakers adopt sustainable, economically viable and environmentally positive agricultural practices.

Mark Edwards/Still Pictures

Demand for food is projected to double within the next 25-50 years as global population increases to 8- 10 billion and food preferences in the developing world change with rapid urbanization and increased per capita income. This will exacerbate the already serious problem of access to sufficient, safe and nutritious food, now affecting nearly 800 million chronically undernourished people. The economies of many developing countries, especially in Africa, are highly dependent on agriculture, and most of the world's people rely on it, directly or indirectly, for their livelihoods. The global community confronts the enormous task of ensuring nutritional security and enhancing rural livelihoods while reversing environmental degradation, redressing social and gender inequity, and ensuring human health and well-being.

Critical environmental and social factors facing the developing world may directly impede meeting the increased demand. They include less water available for crops, due to growing use elsewhere; less arable land, due to urbanization and unsustainable agricultural practices; less labor, due to HIV/AIDS, malaria and other tropical diseases - and to migration from rural to urban areas. ; increased levels of acid deposition and tropospheric ozone; and a changing climate with warmer temperatures, and increases in variability of precipitation, frequency of extreme weather events (such as heat waves, floods and droughts) and loss of land to rising seas.

Agricultural intensification can substantially improve and increase productivity, but it can also have severe environmental consequences. Introducing high-yielding varieties can lead to the erosion of genetic diversity: changes in land cover and agronomic practices can result in soil erosion, and thus loss of essential nutrients and decreased water-holding capacity: pesticides may kill pollinating insects and natural enemies of pests and diseases: applications of agricultural chemicals can contaminate surface and ground water: and intensification can result in increased greenhouse gas emissions, such as methane and nitrous oxide.

Moreover, climate change is likely to compound the negative impact of unsustainable agricultural practices and undermine meeting the projected increase in demand for agricultural products in many developing countries.

Better understanding of sustainable, economically viable and environmentally positive agricultural practices is needed by those who make decisions on agricultural, environmental and macroeconomic policy, nationally and internationally, in both developed and developing countries. This could result in policies and institutional arrangements that facilitate, rather than obstruct, implementing such practices and making advances in science and technology that will help agriculture adapt to rapidly changing environmental conditions and improve its overall performance.

Recognizing the key role of agriculture in the economies of developing countries and in achieving the Millennium Development Goals, the World Bank held meetings with leaders in the private sector and civil society to discuss prominent issues in agricultural knowledge, science and technology (AKST). Participants shared views on how to advance its role in meeting the demographic, environmental and economic challenges facing agriculture. Some suggested that a comprehensive, multidisciplinary international assessment of issues critical to formulating policy would have great value for decision makers confronting conflicting views on such contentious issues as the environmental and human health impacts of transgenic crops, the consequences of bio-energy development on the environment and on the long term availability and price of food, and the implications of OECD agricultural subsidies for small-scale farmers in developing countries.

In August 2002, the Food and Agriculture Organisation (FAO) and the World Bank initiated a global consultative process on a proposed international assessment of AKST's role in reducing hunger, improving rural livelihoods and stimulating environmentally and socially sustainable economic growth. Over the next year eleven

consultations were held - overseen by a multi-stakeholder steering committee - involving over 800 participants from all stakeholder groups. Based on these consultations and on an intergovernmental meeting in Nairobi, the IAASTD was endorsed as a multi-thematic, multi-spatial, multi-temporal intergovernmental process with a multi-stakeholder Bureau co-sponsored by the World Bank, FAO, UNEP, UNESCO, the United Nations Development Programme, the World Health Organisation, and the Global Environment Facility The intergovernmental meeting agreed on its objectives, goals, scope, key questions, design, preparation and peer-review processes, outputs, timetable, budget and governance structure. It is one of the most important assessments to date, dealing with one of the main human needs and rights - for healthy and nutritious food.

The IAASTD's governance structure is a unique hybrid of the Intergovernmental Panel on Climate Change and the non-governmental Millennium Ecosystem Assessment. It is intergovernmental with a multi-stakeholder Bureau comprising 30 government representatives and 30 representatives from civil society (six NGOs, six producer groups, four consumer groups, six private sector entities and eight international organizations) so as to ensure ownership of the process and findings by the full range of stakeholders.

Based on experiences from previous international assessments, the following characteristics are being employed:

- Involving the best experts from all stakeholder groups in their individual capacity in design, preparation and peer-review;
- Conducted according to an open, transparent, representative and legitimate process;
- Evidence-based, not based on value systems;
- Policy relevant, not policy prescriptive, presenting options not recommendations;
- Encompassing risk assessment, management and communication;
- Technically accurate;
- Assessing local, regional and global perspectives as appropriate;
- Presenting different views, with quantification of uncertainties, where possible; and
- Identifying the key scientific uncertainties and areas on which research could be focused.

The goal is help develop - and improve access to - AKST that will promote and facilitate sustainable agricultural practices to improve nutritional security and enhance rural livelihoods, while reversing environmental degradation, redressing social and gender inequity, and ensuring human health and well-being. Within this general aim, its specific objectives are to:

* Undertake one global assessment and five sub-global ones (Sub-Saharan Africa; South and East Asia and Pacific; Latin America and the Caribbean; Central and West Asia and North Africa; and North America and Europe);
- Analyze existing and new technologies, practices and policies and their impact on the development and sustainability goals;
- Provide robust information for decision makers on how to ensure that policies, practices and institutional arrangements enable AKST to meet these goals;
- Bring together the range of stakeholders (governments, NGOs, private sector, producers, consumers, indigenous peoples, the Consultative Group on International Agricultural Research, the scientific community, multi-environmental agreements, and international agencies) involved in the agricultural sector and rural development to share experiences, views, and gain common understanding and vision for the future; and
- Guide future public and private investments in AKST.

The IAASTD is assessing the efficacy of the generation, access, dissemination and use of public and private sector AKST, integrating local (including indigenous) and formal knowledge, and emphasizing gender issues. Knowledge gained from a historical analysis (the past 50 years) and the insights gained from an analysis of possible futures (up to 2050) is forming the basis for assessing options for action on technology, capacity development, policies and funding

.The assessment will provide information on such contentious, complex topics as transgenic crops and bio-energy, but will not set goals or advocate specific policies or practices. It will be policy relevant, but not policy prescriptive, assessing options for action. It is integrating scientific information on a range of topics that are critically interlinked, but often addressed independently - agriculture, poverty, hunger, natural resources, and development. It will enable decision makers to bring a richer base of knowledge to bear on policy and management decisions over issues previously viewed in isolation.

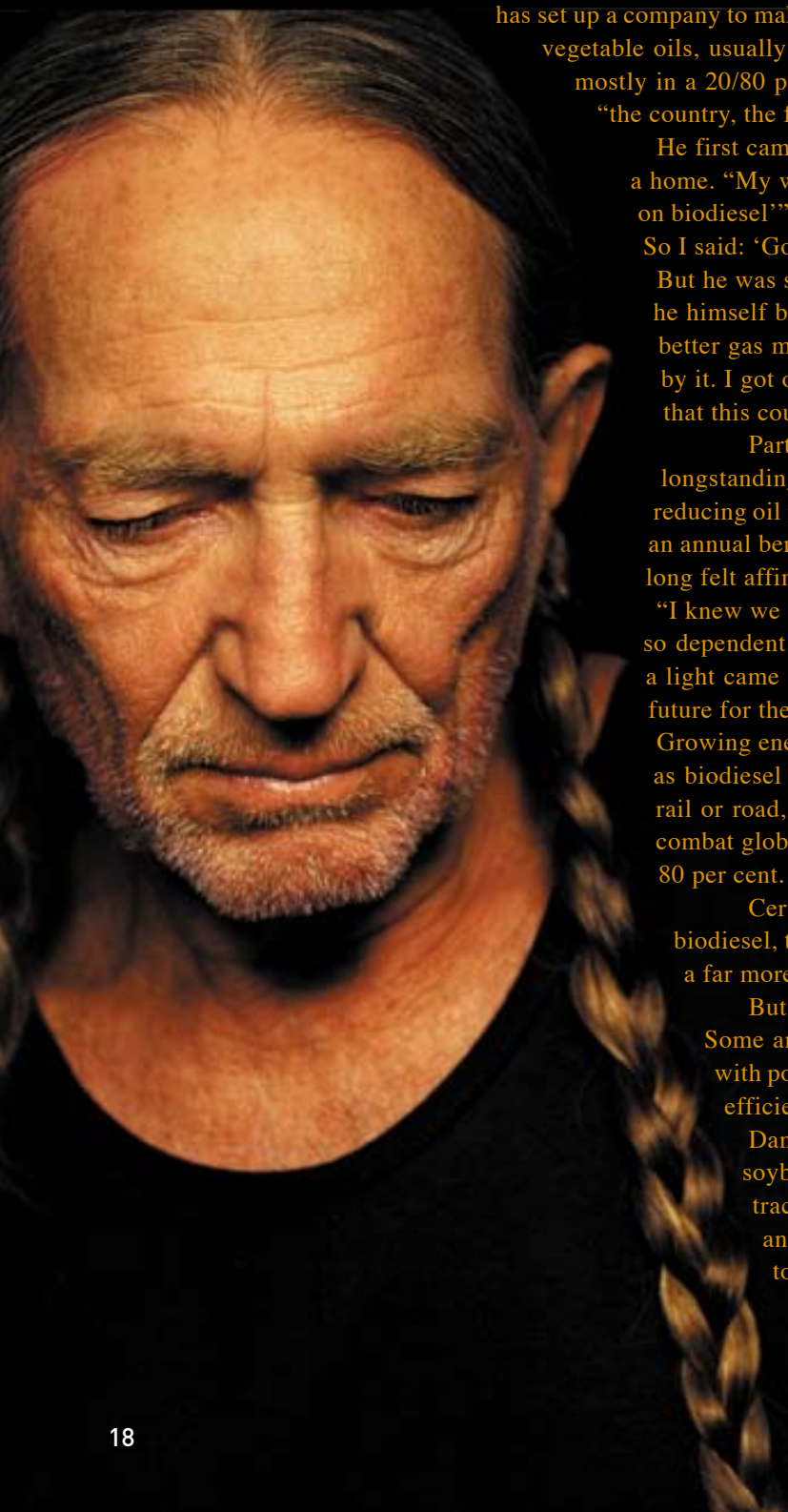
About 400 experts from all stakeholder groups are preparing the IAASTD, which will be completed in late 2007. The global and sub-global assessments are undergoing two rounds of expert and peer-review to ensure they are balanced and technically accurate. A synthesis report will integrate their key findings, and address nine cross-cutting "hot topics" - bio-energy, climate change, transgenics, human health, feminization of agriculture, traditional knowledge innovation, availability and management of natural resources, and public and private investments in agricultural knowledge, science and technology ■

Robert T. Watson is the Chief Scientist of the World Bank and Chair, IAASTD, Hans Herren, President, Millennium Institute and co-Chair, IAASTD and Judi Wakhungu, Executive Dircetor, African Centre for Technology Studies and co-Chair IAASTD.

Star Profile: Willie Nelson

More than a quarter of a century after it first made the charts, the country and western singer Willie Nelson, is giving a new meaning to one of his greatest hits. "On the Road Again", nominated for an Academy Award for the best original song of 1980, could be the anthem of his latest campaign – spreading the growing production and use of biofuel.

The iconic 73 year old musician is a biodiesel pioneer. He does not just burn the relatively low-polluting stuff in his own cars ("the tailpipe smells like French fries") and tour buses, but has set up a company to make and sell it, under the brand name BioWillie. Made from vegetable oils, usually soy beans, it can be burned directly in vehicle engines, mostly in a 20/80 per cent blend with ordinary diesel. He says he is helping "the country, the farmer, the environment."



He first came across the fuel three years ago in Hawaii, where he has a home. "My wife came to me and said 'I want to buy this car that runs on biodiesel'" he recalls. "I thought it was a scam or joke or something. So I said: 'Go ahead. It's your money!'"

But he was soon hooked "I drove the car, loved the way it drove". So he himself bought a Mercedes and fueled it with vegetable oil. "I get better gas mileage. It runs better. The motor runs cleaner. So I swear by it. I got on the computer and punched in 'biodiesel' and found out that this could be the future."

Part of the appeal was that the fuel appeared to match his longstanding concern for family farmers with a new passion for reducing oil imports. Twenty-one years ago, he and two friends created an annual benefit concert to help small farmers, Farm Aid. He also has long felt affinity with truck drivers.

"I knew we needed to have something that would keep us from being so dependent on foreign oil" he says. "When I heard about biodiesel, a light came on and I said: 'Hey here's the future for the farmers, the future for the environment, the future for truckers."

Growing energy crops, he believes, could save family farms. Besides, as biodiesel is not permitted in pipelines, it has to be transported by rail or road, providing employment. And, he adds, biofuels can help combat global warming, by cutting carbon dioxide emissions by up to 80 per cent.

Certainly it is catching on. Over 460 US truckstops now sell biodiesel, though bioethanol, which can be used in petrol engines, is a far more popular fuel there.

But not all environmentalists are enthusiastic about biofuels. Some argue that they will drive up food prices, as they compete with poor consumers for grain – and that they are not even energy efficient.

Daniel Becker of the Sierra Club puts it like this. "To grow soybeans, you need multiple passes over the field with diesel tractors, you need a lot of fertilizer that's energy intensive and, at the end of the day, you have a product that is no boon to the environment."

"If you really want to listen to Willie Nelson, go buy one of his records and play it - while driving a hybrid car." G.L.

BOOKS & PRODUCTS

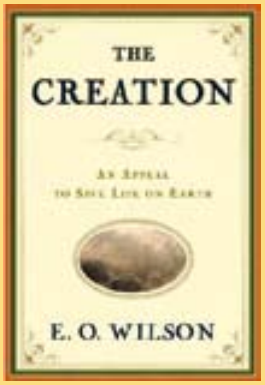
Telecommunications company **02** won the Grand Prix at the first **Green Awards** ceremony held in London's Guildhall on 29 November, for a campaign that sends its cellphone to customers by post, encouraging recycling and avoiding polluting deliveries by courier. It also won the award for the best packaging. The awards — supported by UNEP, Media Guardian, the City of London, Marketing Week, and CSR Wire — have been created to recognize excellent creative work that illustrates and communicates the importance of corporate social responsibility, sustainable development and ethical best practice. **Marks & Spencer**, the leading British chain of clothing stores, also starred on the night, winning several prizes.

"Before a product goes on sale it has already caused several times its own weight in waste" writes **Sachiko Kuwabara-Yamamoto, Executive Secretary to the Basel Convention**, introducing ***Vital Waste Graphics 2***. "Collectively we must reduce waste output at every stage of a product's life, manage waste more effectively, and conserve natural resources." The publication, produced by **UNEP/GRID-Arendal** in collaboration with the Secretariat of the Convention, summarizes key issues and highlights global trends in waste with accessible graphics, maps and texts. It was launched at the **8th Conference of Parties of the Convention**, held in Nairobi from 27 November to 1 December.

Reforming Agricultural Trade for Developing Countries is a two-volume World Bank publication. The first volume, ***Key Issues for a Pro-Development Outcome of the Doha Round,*** takes up select issues of importance to developing countries, including the implications of the concept of the 'multifunctionality' of agriculture, the impact on market access of sanitary and phytosanitary regulations, the role of special and differential treatment for developing countries in the negotiations, and what lessons can be learned from previous trade reform experiences. The second, ***Quantifying the Impact of Multilateral Trade Reform,*** presents several different approaches to modelling the effects of the outcome of the Doha negotiations, and investigates why these (and other) modelling efforts produce such divergent results. Another World Bank publication, ***Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems***, aims to focus on the largely unexplored operational aspects of the innovation systems concept and to explore its potential for agriculture.

Over 35 million volunteers from 122 countries participated in this year's **Clean Up the World** Weekend on 15-17 September. Since it started in 1993, the **Clean Up the World Campaign** – held in conjunction with UNEP – has collected an estimated 3,574,991 tonnes of rubbish, enough to fill 5,710 Olympic size swimming pools. "Clean Up the World mobilizes people around a powerful idea: taking the challenge of environment and sustainable development to our front doors, our back yards, and everywhere else around the globe" says **UNEP's Executive Director, Achim Steiner**. "It comes with another idea that UNEP strongly believes in: that what we consider waste and rubbish today could become a resource for tomorrow."

The Creation; An Appeal to Save Life on Earth, by **Prof. E.O. Wilson of Harvard University** (W.W. Norton) is an attempt by a secular humanist to enlist the religious faiths in averting a mass extinction of species. The eminent scientist – who has won two Pulitzer Prizes for previous books – says that among people of religious faith "there is a potentially powerful commitment to conservation – saving the creation – once the connection is made and once the scientists are willing to form an alliance. There are two world views in conflict – religious and secular – but yet they can meet in friendship on one of the most important issues of the century."



A Matter of Breeding

RAVI PRAKASH SINGH describes how developing crops that are resistant to diseases and pests secures food supplies and protects health and the environment

PHONE Thiriet Claudius / Still Pictures

Diseases and pests have attacked food crops since they were first domesticated and until just four or five decades ago, epidemics caused production losses, food shortages, periodic famines, and malnutrition. Our ancestors selected plants for their genetic resistance – their ability to better resist these attacks – but knowledge of its scientific basis is only about a century old. Today devastating disease pandemics are almost unknown, thanks to genetic resistance developed through modern plant breeding and the coming of chemical controls.

The "Green Revolution" introduced semi-dwarf wheat and rice during the 1960s and 1970s. It both helped feed the world at a time of impending famine and triggered an industrial revolution over the following years. The new varieties' increased production arose not just due to their high yielding ability and higher input efficiency, but also from their genetic resistance to the rust diseases (in the case of wheat) and to blast disease (for rice). Genetic resistance to stem rust disease, caused by the fungus Puccinia graminis, was first incorporated into semi-dwarf wheat by Nobel Laureate Dr. Norman E. Borlaug and has since been maintained through incorporating new genes. Rust resistance has saved billions of dollars annually by avoiding devastating epidemics that would have had major effects on global food supply and prices. Resistant wheat was developed by a global network of scientists who grew wheat germplasm and breeding materials and evaluated them against existing races of stem rust and other pathogens, freely sharing information to develop better public goods.

Were it not for resistant crop varieties, resource-poor farmers who cannot afford pesticides would still be at the mercy of epidemics. Growing them is the best control strategy for poor farmers in the developing world—and the most environmentally friendly and profitable strategy for commercial farmers everywhere. Protecting one hectare of wheat from a rust disease in the highly productive Yaqui Valley of northwestern Mexico, for example, would require one or two applications of fungicides, at a cost of $ 50-100, equivalent to approximately 10-20 per cent of its wheat, which stands at about six tonnes per hectare. Cultivating resistant wheats has avoided the excessive use of chemicals both here and in about two-thirds of the 215 million hectares sown to the crop worldwide. Using resistant varieties thus increases profit margins, helps keep the prices of staple crops affordable, and has a beneficial effect on human health as fewer agrochemicals are applied to the crop.

Genetic strategies

The germplasm of each crop species possesses significant genetic variation for resistance genes. Scientists continually collect natural variation in germplasm from areas where crop species have evolved, so as to conserve genetic diversity for future plant breeding. This is because pathogens display remarkable diversity and the ability to evolve and form new races that can overcome resistance genes, often within just three to five years. Recent biotechnological advances show there is great similarity, in the genetic code, or DNA, of such resistance genes, irrespective of the plant species. These 'race-specific' genes have long been the backbone of resistance, but using them inappropriately can lead to a 'boom-and-bust' cycle: a period of high yields from a widely sown resistant variety, is followed by serious losses when it is attacked by a new race to which it is susceptible, and is not quickly replaced.

Stringent monitoring can identify the presence of a new race long before it causes an epidemic, but most farmers – especially poor ones – do not change varieties until after the devastation. Disease-causing spores of ▶

most pathogens, including those of wheat rusts, can be carried far by the wind to disperse a new race, often aided by the continuous span of major food crops over millions of hectares. These factors have driven the search for alternative, longer term genetic strategies to combat major diseases such as wheat rusts and rice blast, and this has led to using a different type of resistance genes: 'race-nonspecific' or 'durable' ones.

Significant resources have recently been devoted to understanding the genetic mechanism behind race-nonspecific resistance. While race-specific resistance can be imparted by a single major gene having a large effect, race-nonspecific resistance often involves multiple minor genes with small to intermediate, or partial, effects. Accumulating a number of such genes in a single plant can lead to highly effective resistance that can be expected to last over a long period. This has happened in corn where the rapid accumulation of such minor genes has been made possible by its ability to cross-pollinate.

Minor resistance

As wheat and rice are self-pollinating crops, accumulating minor genes in a single plant (along with other important traits) has not advanced as quickly. Characterization and selection for durable resistance to leaf (or brown) rust disease, caused by the fungus Puccinia triticina, were initiated at the International Maize and Wheat Improvement Centre (CIMMYT) in the early 1970s and varieties with moderate resistance were developed soon afterwards. In the late 1980s, research focused on unraveling the genetic basis of resistance to leaf rust and stripe (or yellow) rust (caused by the fungus Puccinia striiformis) and applying this knowledge to wheat breeding. Combining four to five minor resistance genes was expected to produce plants that remained clean even under high epidemic pressure, and such 'slow-rusting resistance' was the basis for generating new wheat germplasm, highly effective against locally prevalent races in many sites internationally.

Some of the highest yielding wheat varieties developed by CIMMYT are now protected by high levels of durable resistance to both leaf and stripe rust diseases. They are at various stages of testing by national programmes, in preparation for release: latest results indicate their yield potential is at least 10 per cent higher than currently grown cultivars. Adopting them will significantly increase production. Perhaps more importantly, their genetic resistance will protect them from leaf and stripe rusts for extended periods, significantly increasing overall profitability. CIMMYT-derived wheat cultivars with two to three minor genes conferring slow-rusting resistance to leaf rust now occupy more than 26 million hectares in developing countries, contributing over $5 billion (1990 US dollars) in yield savings in epidemic years.

The natural diversity in crop germplasm is often enough to provide resistance to various fungal, bacterial, and viral diseases – and to some specialized insect pests – control of other important insects has been made possible through the use of genetically modified crop varieties. Introducing cry genes – also known as Bt genes, originally isolated from the bacterium Bacillus thuringiensis – into cotton and corn is the most notable example of these technologies, which have provided a new dimension to 'insect-pest management': they have significantly reduced the use of insecticides, often very harmful to human and animal health – and to beneficial insects and predators.

Vast destruction

Long-term success often leads to a false sense of security. This has happened with the wheat stem rust pathogen, where a new race – commonly known as Ug99 (first detected in Uganda in 1999) – has established itself throughout East Africa. It could wreak vast destruction on most of the popular varieties grown in this region, as well as in North Africa, the Middle East and Asia, to which it is likely to migrate via the Arabian Peninsula. Other large areas of the world, including in developed countries, are also planted to cultivars susceptible to it. We must shake off our complacency and work quickly and diligently to replace such susceptible varieties with resistant ones before epidemics disrupt the food security and livelihoods of millions of households. Such challenges will continue to emerge for all major crops and will require concerted and integrated strategies to diffuse their effects with minimal intervention from agrochemicals ■

Ravi Prakash Singh is a Distinguished Scientist and Leader of Bread Wheat Improvement for Intensive Agro-ecosystems at the International Maize and Wheat Improvement Centre (CIMMYT), Mexico.

Mark Edwards/Still Pictures

PEOPLE


UNEP

Julia Marton-Lefèvre has been appointed Director-General of the World Conservation Union (IUCN), the world's leading conservation authority, in succession to Achim Steiner, who became Executive Director of UNEP last summer.

Ms Marton-Lefèvre, Rector of the University of Peace in Costa Rica, was born in Hungary, moved to the United States at the age of 11 with her parents – who were political refugees – and has spent most of her adult life in France. She has also served as Executive Director of the International Council for Science (ICSU) and of LEAD (Leadership for Environment and Development).

She says: "Nature and conservation are part and parcel of the world's struggle for development, peace and security. I am dedicated to work with the Union's powerful network of 1,000 member organizations and 10,000 experts to demonstrate the importance of conservation to a fairer and greener planet, as part of my lifelong dedication to the inter-related issues of conservation, environment, development, peace and security."

Valli Moosa, President of the World Conservation Union, added: "We look forward to continuing and expanding upon the work of our previous Director General, Mr Achim Steiner, who put the Union back on the world stage before taking up leadership of the United Nations Environment Programme".


Google

Dr James Hansen, the director of NASA's Goddard Institute for Space Studies in New York, has been awarded this year's Duke of Edinburgh Conservation Medal, "in recognition of his groundbreaking research on man's impact on the Earth's climate and his courage in sounding the alarm."

Dr Hansen brought global warming sharply up the international agenda in 1988 by announcing "the greenhouse effect is here and is affecting our climate now". His testimony to the US Congress on that occasion is featured in former US Vice-President **Al Gore's** film "An Inconvenient Truth". He was presented with the medal, which is awarded annually by WWF, by **HRH Prince Philip, the Duke of Edinburgh** at a ceremony at St James' Palace, London, on 21 November 2006.

James Leape, WWF International's Director General said: "For more than two decades he has made huge contributions to scientific understanding of climate change and to raising awareness among decision-makers and the public."

Accepting the award, Dr Hansen said: "We must move our energy systems in a fundamentally different direction in about a decade, or we will have pushed the planet past a tipping point beyond which it will be impossible to avoid far-reaching undesirable consequences."

Katherine Sierra has been appointed to head a much-expanded vice-presidency of environmentally and socially sustainable development at the World Bank. Already the Bank's Vice-President for Infrastructure since October 2004, she has now combined the two departments in her new role as Vice President for Sustainable Development. A US national who has worked for the Bank for 28 years, she also chairs the Consultative Group on International Agricultural Research (CGIAR).

The new vice-presidency integrates such key areas as energy, water, transport, oil, and mining with environment, social development and agriculture, so as to bring sustainability to the forefront of the Bank's development agenda at a time when infrastructure investments are on the rise.

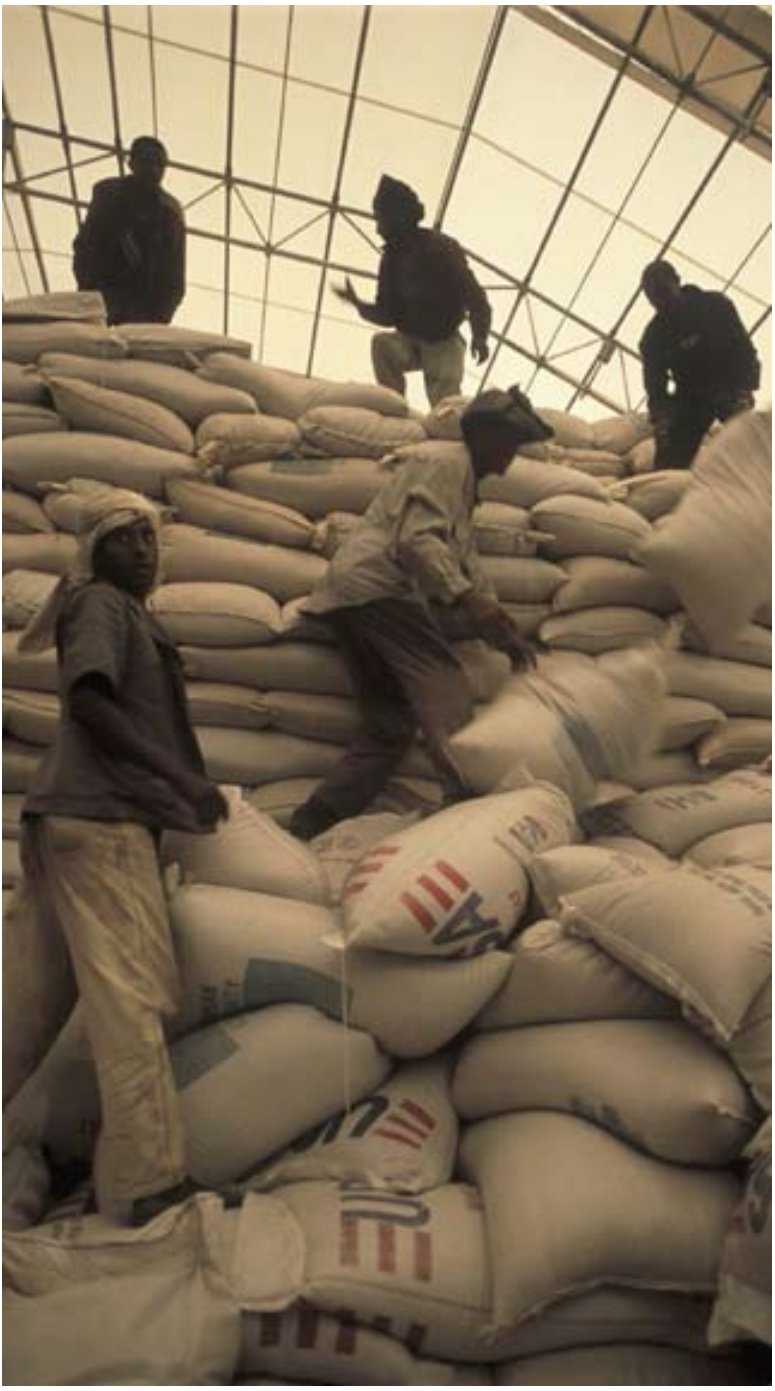

Reuters

World Bank Group President, **Paul Wolfowitz**, says: "The new vice-presidency gives us a unique opportunity to expand our work on sustainable development and move it to a higher level." And Ms Sierra adds: "Much of the infrastructure built in the next 20 years will still be with us in 2050. We have a great opportunity to take actions today that will enhance development options for future generations".

Kristalina Georgieva – a Bulgarian, who has been the Bank's Country Director for Russia – has been appointed Director for Strategy and Network Operations within the vice-presidency.

No Silver Bullets

SUSHMA GANGULY says that agriculture faces complex global and local issues, requiring solutions within the context of sustainable rural development, and outlines how the World Bank is approaching them



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Agriculture is closely associated in the public mind with the Green Revolution which emerged to avoid mass famine and starvation. It largely succeeded by increasing crop yields mainly through improved technology and investments in infrastructure and agriculture services. But a few adverse environmental impacts are also emerging, while the growth in yields it brought has begun to taper off.

Meanwhile increased agricultural productivity in industrial countries, Latin America, and Asia created surpluses, breeding complacency among consumers and policymakers. Support to agriculture, including that provided by the World Bank, waned alarmingly. Land degradation, water scarcity, forest destruction, and over-exploited fisheries increased, damaging the lives of rural people.

Many people think that the world remains awash in food, but this is not longer the case. Now, burgeoning demand for food and feed in fast-growing developing countries—especially in Asia—combined with increased competition for agricultural resources and climatic events in significant parts of the world signal a tightening in world food supplies that may be with us for some time. Global carry-over wheat stocks are at some of the lowest levels ever recorded, equivalent to less than 10 weeks of consumption. Corn and wheat prices have risen by up to 60 per cent this year. In this context, a renewed focus on agricultural research and diffusing technology is more critical than ever.

Higher prices

This is taking place while the recent UN Hunger Task Force found that nearly 800 million people in developing countries already suffer from hunger despite the Green Revolution. The problem is primarily one of access to sufficient safe, nutritious, and affordable food for people who, ironically, live in rural areas and make a living from agriculture. Demand for food will double in the coming decades, primarily in developing countries, as the global population reaches 8-10 billion. So matching production to population growth will remain a challenge.

Increased food supplies will need to come largely from existing land, while using less water. Each year the world loses an area of tropical forests equal to the land surface of Greece, harming water supply and soil fertility. Approximately 40 per cent of the world's crop and pasture land is already degraded or degrading, and an estimated 20 million hectares of cropland go completely out of production each year. About 10 per cent of the world's food is produced using mined groundwater, which—if this continues—could become exhausted or uneconomic to extract.

Higher incomes have shifted dietary preferences to animal products—which some have called the livestock revolution. Meat and milk production in the developing world has doubled in recent decades, and this trend is expected to continue. However, this is intrinsically

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linked to crop production. Lower grain stocks and rising grain prices mean fewer livestock and higher prices for livestock products as well. Even more pressing, while demand increases for fish, approximately 75 percent of the world's marine stocks are overexploited or fully exploited.

The issues are complex and so will be the solutions. Agriculture within rural development is not simply about production, but is linked to natural resources, inputs (fertilizer, seeds), finance, information, water, processing facilities, markets, and ultimately to consumers, both domestic and international. There are also links to overall economic policy, natural resource management, rural non-farm employment, infrastructure, roads, and energy.

Food safety

The World Bank's agricultural agenda is now intrinsically linked to sustainable natural resource management, to the policy environment, to rural livelihoods and institutions, to finance, and to markets and trade. The major issues it is addressing are:

- Promoting trade in agriculture. Agricultural exports from developing countries actually fell over the last two decades, at least partly because agricultural protection (and subsidies) remains high. The World Bank has invested over $581 million in the past five years toward agricultural trade policy reform and about $152 million in helping countries cope with food safety standards that hinder access to export markets.
- Supporting the rural investment climate. The penetration of formal commercial activity into rural areas usually pales in comparison to services available to entrepreneurs in the larger urban and peri-urban localities. This indicates a need for strategic public investment to improve services and facilitate private sector development.
- Providing rural financial services. These underlie all the other interventions supported in rural areas. Investing in them—as the Bank has done in recent years—is critical to developing the rural economy and to helping the rural poor build assets that can decrease their vulnerability to shocks.
- Preparing against emerging zoonoses. Animal-based diseases, such as avian flu and 'mad cow' keep livestock management and animal health at the top of the development agenda. More than 25 countries are expected to receive financing under the World Bank's $500 Million Global Programme for Avian Influenza by December 2006. Effective compensation schemes are essential to induce early reporting and culling, so the World Bank has agreed to lead the process of developing guidelines for them.
- Innovating agricultural research. Shifting demand patterns, improved technology, integrating trade, climate change, and the market are all shaping the evolution of agriculture. The Bank is exploring the concept of innovation systems to handle better these forces. This calls for integrated programmes that address science, private sector investment, the financial system, the policy and regulatory environment, and stakeholder participation. The World Bank's agriculture portfolio is already reflecting this more inclusive, demand-oriented approach.
- Re-engaging in water for agriculture. Agriculture accounts for nearly 80 per cent of global water use, and the World Bank is proactively re-engaging in this area with investments to gain 'more crop per drop'. The Africa Action Plan identified managing water for agriculture as a priority investment area.

▶

■ Managing commodity risk. Price and weather risk management insurance seeks to provide farmers and institutions in developing countries with tools to manage their exposure to fluctuations and potentially expand access to credit. Pilot projects are underway in India, Tanzania, Malawi, Ethiopia, Ukraine, and Nicaragua and under development in Kenya, Thailand and Cambodia.
■ Empowering rural communities. Putting the poor 'in the driver's seat' of development, creates systems that respond to demand and makes governments, NGOs, the private sector, and donors accountable to the poor. Over $1 billion were invested in this approach in agriculture and rural development in 92 countries in the 2005 financial year alone.
■ Securing access to land. The World Bank's work on land administration addresses: the role of the state in establishing secure property rights; well-functioning land markets to provide access; the social and economic costs of highly unequal land distribution; and the appropriate regulatory environment for effectively dealing with land. Over the last five years the Bank has invested just over $1 billion through 74 projects.
■ Investing in core public goods in rural areas. This contributes to the overall well-being, productive capacity, and economic potential of the rural population. Reflecting its importance, and the multi-sector nature of rural development, 30 per cent of lending in rural areas financed infrastructure investments, 20 per cent financed social sectors, and 19 per cent financed law, justice and public administration.
■ Water Resources Management. By 2025, some 48 countries—mostly least developed ones — and over 1.4 billion people will be experiencing water stress or scarcity. The World Bank focuses on the management and governance of water for responsible growth that benefits the poor. It concentrates on broad-based river basin management and smart water storage schemes, on restoring degraded water quality, and on improving water services. And it incorporates adaptation to climate change and multi-objective water planning in the design and implementation of its operations.
■ Natural Resources. World Bank investments in natural resources are beginning to focus more on integrated ecosystems management, simultaneously addressing forest, land, and water resources. They are also concentrating more on community participation, on institutional development, and on capacity building for economic development, environmental conservation, and poverty reduction.

Sustainable basis

Agriculture faces complex issues which do not respond to the desire for a silver bullet. Donors have tried several of them—integrated rural development, training and visit extension—and recently some have argued for universal fertilizer subsidies. All have failed. In future, we must evaluate the entire value chain of agriculture through marketing and processing (from fork to plough) and decide how best to improve the productivity and effectiveness of the land, water, labour, capital, institutions, and markets that contemporary farmers rely upon to grow and sell their food. There is room for everyone—donors, governments, the private sector, and NGOs alike—to scale up activity on a sustainable basis ■

Sushma Ganguly is acting Director for Agriculture and Rural Development at the World Bank.

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Matters *of Debate*

CALESTOUS JUMA argues that the fierce controversy over agricultural biotechnology will die away as it produces an increasing range of useful products – and warns against premature regulation

Adrian Arbib / Still Pictures

The intensity of the debate over agricultural biotechnology has created the impression that it carries unique risks, requiring regulation through unique approaches. But it is just part of a long history of public discourse over new products. Claims about the promise of new technologies, especially when overstated – as is common when they face social and other barriers – are often greeted with skepticism, vilification or outright opposition.

Some of the most widely consumed products have endured decades or centuries of persecution, often mainly from political and economic forces associated with incumbent products and views. In 1511, for example, Khair Beg – a viceroy and inspector of markets in Mecca – outlawed coffee consumption and coffeehouses, on the grounds that the beverage had the same impact on human health as wine. But his real motive was partly the coffeehouses' role in undermining his authority and offering alternative sources of information on social affairs.. His masters in Cairo, however, castigated the scientific basis of the health claim and ruled that nobody would be denied access to heaven for drinking coffee.

Nevertheless, public smear campaigns alleged that the beverage caused impotence and other ills and it was also either outlawed or restricted in Istanbul, England, Germany, and Sweden. In 1674 a French crusade to defend wine consumption argued that with coffee drinking "the body becomes a mere shadow of its former self; it goes into a decline, and dwindles away. The heart and guts are so weakened that the drinker suffers delusions, and the body receives such a shock that it is as though it were bewitched."

Modified organisms

Today's debates about agricultural biotechnology display some of the same characteristics. Its critics use mass communication to highlight the dangers they attribute to it. Its advocates have been forced to respond and have only rarely taken the initiative to reach out to the public. Critics build on the general distrust of large corporations and the growing disenchantment with some aspects of globalization – and make effective use of incidents, amplifying their risks. One example is a widely-quoted study by Cornell University researchers indicating that pollen from GM corn (producing a Bt toxin) killed the larvae of Monarch butterflies. It was used to amplify the impact of agricultural biotechnology on the environment, and subsequent peer-reviewed explanations of its the limitations and refutations of the conclusions did not change the original impression.

The United Nations has played a key role in promoting dialogue and debate on the risks and benefits of agricultural biotechnology. One of the most important outcomes is the landmark Cartegena Protocol on Biosafety to the Convention on Biological Diversity which has become a key source of normative standards on international trade in living modified organisms. ▶

But the critics have redefined the rules of the debate in three fundamental ways. First, they shifted the onus of demonstrating the safety of agricultural biotechnology products onto the producers, considering them unsafe until proven otherwise. This thinking influenced the original design of the Cartagena Protocol and still serves as a guiding principle for much of the opposition. It ignores the fact that risks are relative, and that in some cases doing nothing may entail greater risks than adopting a new technology.

Second, the debate is framed in environmental, human health and ethical terms, masking the underlying international trade considerations. The World Trade Organization's recent ruling on a dispute between the US (and several of its agricultural biotechnology allies) and the European Union has helped highlight its the trade aspects.

Thirdly, the locus of negotiations on a treaty that seeks to regulate trade has been shifted to environmental institutions, disenfranchising trade and agricultural constituencies likely to be affected by the decisions. New technologies do not generally get a fair hearing in environmental circles.

Public debate

Much of the debate in developing countries is based on hypothetical claims: there are no tangible products in the hands of producers or consumers. Ample evidence suggests that concerns over the safety of new products tend to decline as local participation in, and ownership of, new technologies increases. Similarly, local participation in choosing technologies increases trust in their use, reducing the demand for non-science-based safety regulations. And trade in technology-based goods helps to raise trust among trading partners.

Thus spreading the use of agricultural biotechnology not only promotes familiarity with it, but generates the information needed to convince the public of its relevance and usefulness. Broadening the range of products is therefore a key strategy for settling the debate. This is particularly important in African countries interested in using the technology to enhance local products and diversify their food base – through, for example, drought-tolerant crops.

General debates about the role of agricultural biotechnology have little utility unless framed in the context of local needs and applications. Treaties adopted in anticipation of technological change therefore risk being rendered irrelevant by the decisions of farmers and consumers. This is not to say that such treaties are not necessary; but their clauses need to be crafted with flexibility to support technological advances while providing safeguards against potential risks.

The biotechnology debate has pushed the frontiers of public discourse of technical matters. On one hand, society is being forced to address inherently technical issues; on the other, the scientific community is under pressure to accept non-technical matters as valid inputs to decision-making.

Policy-oriented research institutions and think tanks play an important role in this war of words. Critics of biotechnology have made a considerable effort to create alliances with research institutions, including university-based departments, and much of the material used to question the safety of biotechnology often has the legitimacy they confer. Non-partisan policy research on the role of biotechnology in society is largely lacking. So those seeking to provide an alternative view have limited opportunities to obtain credible information.

The lack of systematic research on the interactions between biology and society is a critical bottleneck in efforts to engage the public in dialogue on biotechnology – particularly as advances in biology pose new ecological and ethical issues associated with the physical and chemical sciences.

Much of the public debate is intended to influence government policy – and the capacity of governments to assess the available information, and use it for decision-making, is an essential element. Political leadership is an essential aspect of the governance of new technologies, as is the existence of the requisite institutions of science and technology advice.

Debates over new technologies will be more pronounced in future, and governments will increasingly come under pressure to address them. But advice on science and technology will not be sufficient unless governments view them as integral to the development process. Enhancing the capacity of leadership to address science and technology issues will enhance effective management of public debates over new technologies in general and biotechnology in particular.

The scientific community will need both to demonstrate a clear sense of leadership, and to adapt its methods of communication to suit the growing complexity and diverse needs of the global community. In the final analysis, it is the range of useful products available to humanity from agricultural biotechnology that will settle the debate, not the rhetorical pronouncements of advocates and critics. International treaties will be more relevant when they co-evolve with technological innovation, rather than running well ahead or far behind ■

Calestous Juma, a UNEP Global 500 Laureate from Kenya, is Professor of the Practice of International Development and Director of Science, Technology and Globalization at Harvard University's Kennedy School of Government

Organic

Growth

ANGELA B. CAUDLE describes how organic agriculture is booming in developed countries and helping to meet the Millennium Development Goals in developing ones

Organic agriculture has truly gone global, in its development and growth. It has long been billed as a labeling and marketing scheme for niche markets in developed countries, mainly focused on yuppie consumers, but, if this was ever the case, it is certainly so no more. It has been growing consistently at up to 20 per cent a year over the past decade– becoming a veritable production system and moving into an increasingly mainstream and global marketplace. At the same time its potential for rural development in developing countries has been recognized.

This move into the mainstream has caused controversy, particularly as such economic giants as Wal-Mart begin to engage in this very lucrative endeavour. And its recognition as a major tool for reaching the Millennium Development Goals (MDGs) and for rural development has not been universal: indeed , in many parts of the world, it has been depicted as an attempt to leave developing country producers without access to modern technology, which is often perceived as superior to traditional systems.

Consumer confidence

Many pioneers of organic agriculture, and the standards associated with its verification process, began with a strong commitment to supporting farming and food systems, which build a healthy environment, communities and people. It was recognized early on, that organic standards could be watered down as industrial agriculture and big business got involved. So the three major developed country standards (US, EU and Japan) are regulated by their governments to protect the integrity of organics and preserve consumer confidence.

Some argue that the government regulation process has validated the entry of lesser organic producers into the system. It has undoubtedly created an environment that has allowed for fast and furious growth in developed countries. Until recently, most big business has only been involved in a very limited and cautious way, although its participation is constantly increasing. Its involvement has already caused contention in an organic movement riddled with fears that consumers will lose confidence in big business organics, and that these giant players would push constantly to lower standards.

What does it mean when Wal-Mart – the world's 20th largest economy – makes a public organic commitment? Besides bringing fears of the 'dumbing down' of organics, it undoubtedly moves them into a larger share of the market place and increases the availability of products to the average consumer. Many ask: "What is the problem with this?" In such a hyper-regulated industry, why do we feel the need to differentiate one organic from another? Perhaps it is more important to look at the effect on global agricultural production systems as more and more farmers change to organic to meet increasing demand.

Emerging markets

In developing countries, three different scenarios prevail. Some have little or limited organic production; others have emerging markets and production, both for domestic use and for export; still others enjoy booming markets. Agriculture – generally subsistence farming – remains predominant in most developing countries. In all three scenarios there is

Martin Bond / Still Pictures

a strong case to be made that organic agriculture suits rural development: it clearly brings tangible benefits, both in income and the quality of life, to the world's poorest people.

As aid agencies and governments search for solutions to combat growing poverty in many developing countries, organic agriculture has increasingly been recognized as a tool for rural development – and for its direct and indirect contribution to meeting the MDGs. It contributes directly to alleviating poverty and increasing food security, and indirectly to greater health and better environmental conditions for local communities – ultimately boosting the standard of living.

Traditional practices

As organic consumption grows in developed countries, more and more products will be sought from producers in developing ones. Indeed Wal-Mart's entrance into the organic business creates a demand that cannot be met without sourcing from them; first, because the supply is simply not available in developed countries, and second, because they are committed to getting organic products at the lowest possible price to maintain their discount model. This gives farmers in developing countries an opportunity to go organic, and thereby increase their income, if they have the necessary knowledge and support. This is already happening in emerging and booming markets, thanks to demand for exports. In China, India and Brazil, which have significant middle class populations, the domestic market has also begun to surface and thrive.

Thus, organic agriculture, at its best, promotes sustainable rural development in developing countries and provides a framework for codifying and marketing traditional practices both to produce for growing local and regional markets and to supply the great demand from developed nations. In the industrialized world, organic products are progressively moving into the mainstream with an ever-increasing market share. If organics are to continue to succeed worldwide, developed country players must find a level of comfort with big business, avoid internal divisions that divide the industry and cause consternation to consumers, and support the entry of developing country producers into the movement ■

Angela B. Caudle is the Executive Director of the International Federation of Organic Agriculture Movements (IFOAM).

Basic Principles

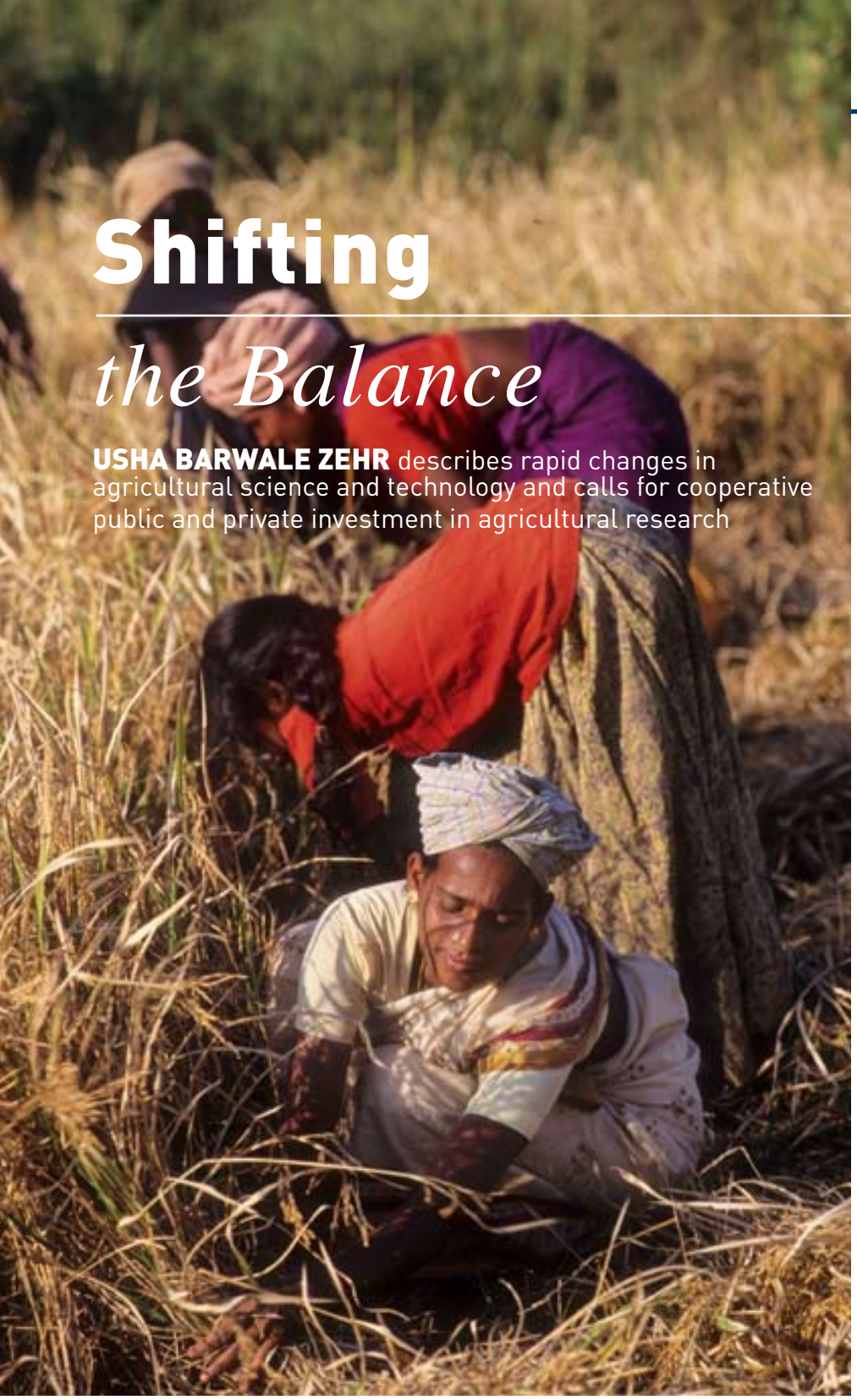
The International Federation of Organic Agriculture Movements (IFOAM, 2005) has developed the Principals of Organic Agriculture through a globally representative participatory process, demonstrating the overarching ideas behind organic production regardless of place, scale, or standard in use.

They are:

- *The Principle of Health* - Organic Agriculture should sustain and enhance the health of soil, plant, animal, human, and planet as one and indivisible.
- *The Principle of Ecology* - Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
- *The Principle of Fairness* - Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
- *The Principle of Care* - Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and the environment.

Shifting *the Balance*

USHA BARWALE ZEHR describes rapid changes in agricultural science and technology and calls for cooperative public and private investment in agricultural research



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Over the last decade, agricultural research and development has been undergoing constant change worldwide. The introduction of genetically modified crops in the USA in 1996 – and then in several other developed and developing nations – has led to faster adoption of new technologies than ever seen before. These have brought direct and indirect benefits to producers, consumers and the environment. Their positive impacts are immense, while the need for improvements in agricultural productivity remains high. It is important to examine mechanisms for ensuring that these benefits can be realized not just by a select few, but become available to producers around the world.

The last decade has also seen a shift in the proportions of agricultural research funded by the public and private sectors. There has been greater private investment in developed countries, and the shift is also seen in developing nations. This implies that there is an immediate need to look at the following:

a) National technology development programmes that include natural resource management, traditional approaches, and biotechnological interventions involving not only genetically modified crops but the use of molecular markers and other tools for efficiency improvements.

b) Accessing available technologies from around the globe. The resources of both public and private sectors can be better used for innovation than in creating a tool or technology which has already been developed.

c) Balancing discussions on intellectual property issues to permit the highest level of investments in agricultural research.

d) The need for strong regulatory mechanisms and government policies to encourage research and development.

Environmental security

Historically, the Green Revolution brought remarkable achievements. Several countries went from starvation to self-sufficiency through a primarily public sector undertaking. Today's challenges must deal with nutritional and environmental security, as well as making enough food available.

Indian agriculture, for example, is at a crossroads. Food production is rising every year, and improvements in the use of fertilizer, pesticides, irrigation, and quality seed have significantly improved productivity. Yet, several concerns need addressing. Agricultural policies

Already private investments equal or surpass public ones in developed countries – thanks to policies that adequately protect private sector interests – and the same trend is emerging in some developing ones

need to change to suit the diversity of farm sizes and cropping patterns, the growth of the livestock and poultry sectors, and economic developments. India has around 11 per cent of the world's land under agriculture, but the productivity of many of its crops and much of its livestock remains low. And weaknesses in post harvest technologies and a low level of integration with the food processing industry creates barriers to achieving sustainable food security.

Agricultural investments were once seen as a matter only for the public sector, but this has now changed. Already private investments equal or surpass public ones in developed countries – thanks to policies that adequately protect private sector interests – and the same trend is emerging in some developing ones. The private sector is very heterogeneous with several large players and hundreds of medium and small enterprises. Its size and diversity have necessitated interaction and partnerships within it to access markets and technologies or for other commercial considerations.

For its part, the agricultural input sector has a long, eight to ten year product development cycle, and requires risks to be minimized and external factors – which may affect the development or launch of products – to be defined in government policies upfront. This adds to the challenge for private sector investments in agriculture, necessitating clear focus on areas where the possibilities of success outweigh the risks.

Agricultural research

The globalization of agriculture has shifted the focus of large companies from the mature markets of developed countries to those in developing ones. Developing country markets provide great opportunities for new business, but bring concerns over government policies and intellectual property protection. The protection available varies from country to country. The USA, for example, offers all forms – patents, plant breeders rights, and such other devices as trademarks, contracts etc. – while in many developing countries property rights for agricultural research will take time to be turned into laws.

This presents major challenges. Indian private sector seed industry investments, for example – in an environment where no such protection has been available – have focused on crops where hybrid seed could be produced and marketed, giving a short lead in the market before it can be duplicated. There is no incentive to put money into research if there are no mechanisms for return on this investment. Add the vagaries of the monsoon, up and down profitability cycles, changing cropping patterns, and impacts on market price impacts, to name a few, and committing resources to research becomes a daunting task. The greater the clarity over intellectual property, regulatory affairs and other related policies, the greater the prospects for more private investment in research.

Public funding

A shift from chemistry to genetics and biotechnology is also changing agribusiness. Advances in computing technologies and biological sciences allow genetic information to be linked with genomic information, feeding into mathematical equations, bioinformatics and statistics to deliver better products quicker, with a higher rate of annual gain. The expertise now needed is not just in genetics, plant breeding or biotechnology, but in a cross-functional approach, maximising research capabilities. Similarly, investment can no longer just be in one area, but requires many partnerships and capacities if substantial outcomes are to be achieved.

Traditionally public funding has gone exclusively to public sector institutes in developing countries. It is time to look more broadly at what organizations, public or private, can deliver a superior product, faster and at lower cost. Both sectors must prosper and grow given the diverse nature of agriculture in all its forms. For instance,there are many opportunities in India for commercial business, subsidized business in emerging markets and humanitarian partnerships, and public goods.

New molecular tools have greatly reduced the time needed to introduce new products through plant breeding research, which has progressed from land races, to high yielding hybrids and genetically modified crops. Some institutes are better able to use them than others, and they must now be adopted by more researchers. The need of the public sector to contract out research to the private sector has opened new avenues for collaboration, bringing in more private resources.

Productivity gains

Thus agriculture has undergone dramatic changes from a primarily public sector enterprise to being dominated by private enterprise. Technological inputs in all areas have undergone quantum changes, largely driven by the private sector. This changing scenario presents both an opportunity and a challenge for agriculture. Privatization has changed the commercial incentives for participants. The private sector is more interested in investing in long-term research and development, moving away from trading-related businesses. Government policies urgently need to translate this private sector interest in agricultural research into incentives for substantial long-term investments. Outsourcing, collaborating and new models must be seriously considered if economic productivity gains are to continue. Organizations that can deliver cost-effective outcomes should be invited to participate in all agricultural research activities, whether they be public or private in nature ■

Usha Barwale Zehr is Joint Director of Research at Maharashtra Hybrid Seeds Company Ltd.

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UNEP Sasakawa Prize

The UNEP Sasakawa Prize, sponsored by The Nippon Foundation and founded by the late Mr. Ryoichi Sasakawa, is awarded annually to individuals who have made outstanding contributions in a specific environmental area. For more than 20 years, the UNEP Sasakawa Prize has been a mark of excellence in the environmental field. Between 1984 and 1993 the UNEP Sasakawa Prize was awarded to 30 laureates. In 2004, all the laureates were invited to Beijing, China, to celebrate the Prize's 20th anniversary and discuss issues and strategies for a sustainable future.

On World Environment Day 2005, UNEP and The Nippon Foundation launched the new UNEP Sasakawa Prize to nurture environmental innovation, research, initiatives, and ideas on an annually changing theme. The Prize, worth US$200,000, is considered one of the most prestigious environmental awards in the world and recognizes innovative research and ideas, and extraordinary grassroots initiatives from around the world. Each laureate's scope of activities is associated with an environmental theme selected for the year.

The theme for 2007 is

Climate Change

For more information, or to nominate a candidate for the 2007 Sasakawa Prize, please go to

http://www.unep.org/sasakawa/

Rodrigo Vivas Rosas

Tenadi Cooperative Group

In 2006, the theme was 'Deserts and Desertification. Two grassroot initiatives – the Tenadi Cooperative Group of Mauritania, and Rodrigo Vivas Rosas, leader of the Inter-institutional Consortium for Sustainable Agriculture (CIPASLA) in Colombia – were the 2006 recipients. They were recognized for their achievements in combating desertification and land degradation—a major local and global problem that threatens the lives and livelihoods of two billion people inhabiting the planet's dry and arid areas.

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