CGIAR NEWS

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MTM97

Biotechnology in the CGIAR

In his opening statement at the 1997 Mid-Term Meeting in Cairo, Chairman Ismail Serageldin urged the Group to frontally address the many issues raised by the changing framework of biotechnology research and application. These issues include ethics, equity, biosafety, and proprietary science and technology. He indicated that biotechnology is a tool, to be used with other tools, to pursue the mandate of the CGIAR, and that the CGIAR may have to increase its capacity to deploy that tool as effectively as possible.

The Group discussed the present role and future scope of the CGIAR's efforts in biotechnology research, in the context of the rapidly advancing developments and escalating investments in biotechnology by both the public and private sectors globally. The following text describes some highlights of the MTM97 discussion on biotechnology.

The value of the private sector and NGO community participating in the CGIAR's discussions on biotechnology was recognized. The perspectives of the Private Sector Committee and the NGO Committee were welcomed.

The importance of biotechnology as a powerful tool of modern science that must be used appropriately was emphasized. There is substantial potential for biotechnology to contribute to more rapid and sustainable agricultural growth in developing countries, particularly in the solution of intractable problems. Given this potential, the CGIAR was urged to become a more significant global player in biotechnology, by raising its capacity and profile in select biotechnology areas of particular relevance to agriculture and natural resource management in developing countries.

The CGIAR must ensure that its biotechnology research is geared toward solving the problems of poor farmers rather than toward scientific priorities, i.e., technology, should be needs-driven rather than science driven, as the latter

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Progress in Research on Tropical Forests—Five Years After Rio

An interview with Jeffrey A. Sayer (CIFOR)

Q: Five years after the adoption of the much publicised Forest Principles at the Earth Summit in Rio has there been significant progress in research on tropical forests?

A: A number of initiatives came out of Rio, most of which had built in scientific support mechanisms. The Climate Change Convention had its Intergovernmental Panel on Climate Change. The Biodiversity Convention

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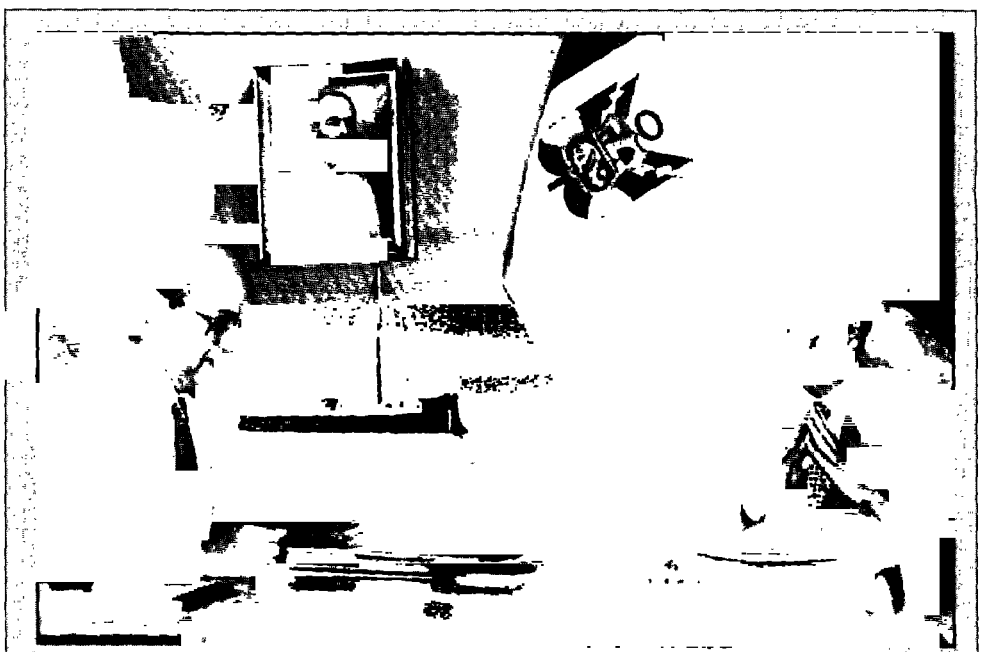

As a result of discussions between President Alberto Fujimori of Peru and Chairman Ismail Serageldin on August 5, Peru joined the CGIAR as the Group's 56th member. Peru is the host country of the International Potato Center (CIP). (Photo: Government)

Get on a Bus... How to Alleviate Rural Poverty

The main agenda item of the CGIAR Mid-Term Meeting 1997 in Cairo was the discussion of the Medium-Term Research Plans of the CGIAR centers for 1998-2000 in light of the principal elements of CGIAR priority setting, a people-centered focus, and a strong emphasis on poverty alleviation and on the protection of natural resources. An earlier ICARDA case study[1] provides some food for thought on how to tackle rural poverty and on the paradigm of poverty alleviation.

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A joint study undertaken by the Turkish Central Research Institute for Field Crops (CRIFC) and ICARDA in the Sivas-Kayseri provinces of eastern Anatolia revealed that in the smallest farm category—less than 10 hectares—a full 58 percent of labor (expressed in available days) was not used. This is not surprising since the study also found that selling surplus crop production in the market resulted in a net income loss for small farmers of US$5 per capita, compared to a total farm cash income of $180 per capita, of which 41 percent came from on-farm production, the rest from off-farm activities. Had the farm not engaged in crop production it would have gained $79 from farm production, mostly from the sale of livestock. Instead, the loss from crop sales reduced per capita income from farm production to $74.

In the Sivas-Kayseri region, wheat and barley are the main field crops. Low wheat prices were considered the main cause of the unprofitability of crop production which was, nevertheless, maintained to support family consumption. The study team assumed that in this area wheat production was profitable only on large farms.

A situation in which the farmer incurs a loss in the main farming activity may appear absurd, but is it really? How many smallholders in developing countries are subsidizing crop production in order to maintain subsistence food security?

The researchers found a number of shortcomings in agronomic practices in the area which can be interpreted both as consequence and cause of the prevailing dire conditions: low yields resulting from inadequate tillage for moisture conservation, ineffective seed-bed preparation, poor seed quality, inappropriate seeding rates and dates of planting, and inadequate fertilizer application.

How about productivity raising investments? The study team found that small farms carry a relatively heavy $64 per capita debt burden, mainly from earlier forays into public credit financed mechanization. In view of the losses in crop production combined with the need to service old credits, it is hardly surprising that small farmers are forced to disinvest by forgoing maintenance on capital goods, especially farm buildings. "We found evidence that subsistence farming is subsidized not just by off-farm income, but also by spending fixed assets. How long does this go on before the fixed asset being sold is the land itself?"

The study team found no evidence of remittances from emigrated family members which in other areas of West Asia and North Africa help close the income gap. Also, the Sivas-Kayseri region is characterized by a labor surplus, not only among smallholders, but also on large farms which, for that reason, have little demand for wage labor.

Off-farm income from tractor hire and the sale of handicrafts, especially rugs, apparently did not suffice to sustain the family subsistence production over the long term, although it probably absorbed part of the 58 percent of work days not needed in farming. "The only solution would be to get on a bus," the study team felt. A bus to where? Millions of economic and environmental refugees in and from developing countries have already left for the cities or abroad.

What is it that squeezes these smallholders out of subsistence? Is it the world market with its low prices for their main crops? Is it the inability to find more

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[1] "Is Time Worth Money in Sivas and Kayseri?" by Richard Tutwiler ICARDA Caravan No 1, Autumn 1995.

Alleviating Rural Poverty

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gainful off-farm employment? Is it per capita disinvestment resulting from past population growth which inflated farm families beyond the income generating capacity of their fixed assets? Or is it lack of access to improved farm technology suitable for poor smallholders?

Existing literature on subsistence farming somehow suggests that subsistence equals poverty, but that this level of poverty is sustainable because it is isolated from the risks of the market. The CRIFC/ICARDA study shows that in the real world this isolation does not exist because today's subsistence farmers need a cash component of income. Only if this cash income is sufficient to sustain subsistence without de-investment, the prevailing level of poverty can be considered sustainable or, to use an old-fashioned term, chronic. If the cash income is below this threshold, the small farmer's poverty level must be considered unsustainable. Once the family's subsistence is lost, the family will either perish, or migrate and perish, or migrate to join urban poverty, or migrate and get out of poverty.

The concept of poverty alleviation, seen in this light, appears to be a deceptive and euphemistic paradigm. In the case of unsustainable subsistence the foremost objective must be to stabilize the poverty. Technologies, policies, and extension packages need to be designed to break the downward spiral, close the income gap, and help sustain the fixed farm assets of millions of small farmers, especially women. On a higher plane, this objective may mutate into the need to stabilize the poverty of entire nations, particularly in sub-Saharan Africa, whose economy is based on unsustainable small-scale farming.

The CRIFC/ICARDA study pointed to a way out which at first glance might look odd to the economist, but makes sense in its context: substitute labor for capital. By posing the question "Is time worth money in Sivas and Kayseri?" the study team pointed to the central problem of the rural poor: the close to zero value of their labor's marginal product. To raise labor productivity, the researchers recommend more intensive animal husbandry together with income generating sales of milk, butter, yogurt, meat, etc., in combination with a fallow replacement scheme. All this needs to be done with labor instead of capital.

Experience suggests that the farmers probably have already tried most of these ideas, but for one reason or another they did not work. Obviously, what small farmers need is free access to better technologies and/or a different policy environment, which makes intensive animal husbandry, fallow replacement, etc., remunerative—changes which can only be brought about by public sector action.

In essence, what the study says is that stabilizing—and alleviating—poverty requires substituting labor for capital and raising the labor productivity of the poor without investment in the physical capital stock.

What the case study suggests for CGIAR priorities and programs is that the Group's people-centered poverty focus implies concentrating research efforts on products and policies appropriate to stabilize and alleviate the poverty of the rural poorest, the subsistence and part-subsistence farmers. Research products should be suitable for the small farmer, especially women farm heads, be available free of charge, be easy to access and apply, and be labor based by not presupposing the existence of capital goods nor requiring new investment. From the part-subsistence farmer's perspective, it is probably more important to improve the market oriented part of farm activities—in the case of the Sivas-Kayseri study, livestock production—than the mainly subsistence oriented work—in this case, crop cultivation—unless a quantum increase in productivity in the latter activity can be achieved.

FORUM

Attacking the Root Causes of Instability

by Per Pinstrup-Andersen (IFPRI)

Tragedies such as those in Burundi, Rwanda, and Somalia are well publicized by the international news media, but such stories are only the tip of a much bigger iceberg. Chronic instability is simmering in dozens of the poorest developing countries, which are burdened by rapid population growth, slow economic growth, weak governments, and low human development.

Ethnic tensions and political rivalries are the usual purported causes of these situations, yet there is no doubt that the real causes go much deeper than that. Weak agriculture sectors, food insecurity, hunger, and environmental degradation are certainly big contributors to chronic instability and conflicts in developing countries.

Virtually throughout the developing world, farmers are working on tiny plots and eking out barely enough to feed their families. Such situations are a breeding ground for desperation and conflict. In many countries, internal migrations are clearly connected to the problem of too many people farming on too little land, or of new entrants having little or no access to existing land. Often, such migrants move to forest areas or more marginal lands, a process that may undermine a nation's natural resource base and diminish prospects for future growth.

The inability to muster more than a marginal living has another important effect: it reduces the overall purchasing power of rural people and, thus, plays a major role in the inability of rural economies to contribute to national gains in economic welfare. Furthermore, economically marginal farmers rarely have the financial resources

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RESEARCH HIGHLIGHTS

Centers Declare Victory Over the Cassava Green Mite

The Cassava Green Mite (CGM) is a pest responsible for between 30 and 50 percent yield loss of cassava, a starchy root crop that is a staple food for more than 200 million people in sub-Saharan Africa. Rich in calories, highly drought tolerant, thriving in poor soils, and easy to store in the ground, cassava is popularly called "the staff of life" for the poorest of the poor in Africa.

A breakthrough in CGM control was made possible through identification and mass release of an effective natural enemy of the CGM in Africa's cassava regions. Peter Neuenschwander, Director of Plant Health Management at IITA in Ibadan (Nigeria), says: "The institute had chosen the option of a classical biological control strategy to fight crop pests and diseases because it constitutes the most environment-friendly technology."

In the early 1990s, IITA had already achieved a substantial breakthrough by introducing a biological control method which virtually freed sub-Saharan Africa of another important pest, the cassava mealybug. "The new breakthrough in CGM control through the use of predatory mites constitutes another milestone in the classical biological control of crop pests and diseases," says Neuenschwander. "However, the green mite has been much more difficult to control than the mealybug—using the same biological control methods—because so little is known about mites in general, and especially mites on cassava."

When both the cassava mealybug and the CGM appeared in the African continent in the 1970s, causing widespread damage and loss, the lives and livelihoods of millions of people were threatened. The first outbreak of the CGM, *Mononychellus tanajoa*, (in French: *acarien vert*) was noticed in Uganda in 1970. The pest now covers

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ANNOUNCEMENTS

Thailand, New Zealand and Peru have joined the CGIAR, thereby increasing the total membership to 56, and the number of developing country members to 19. All three countries had closely cooperated with CGIAR centers in the past

Wanda W. Collins, a highly regarded plant breeder and geneticist, has been appointed Deputy Director General for Research at CIP. Wanda Collins, an American, is professor of horticultural science at North Carolina State University at Raleigh. One of her principal responsibilities will be to lead an international team of pathologists and molecular biologists to halt the damage caused by new forms of potato late blight disease. She will also head a program to increase the productivity of sweetpotatoes grown in developing countries. Wanda Collins currently chairs the IPGRI board and is on a two-year assignment with the World Bank as an agricultural research adviser in environmentally sustainable development. (CIP)

Jerry Vanclay of Australia, a Systems Analyst at CIFOR, has received the prestigious Queen's Award for Forestry. Dr Vanclay holds degrees from the Australian National University at Canberra, University of Queensland, and the University of Oxford. Before being appointed to CIFOR he held a number of important positions in the Queensland Forest Service and was Professor of Tropical Forestry at the Royal Veterinary and Agricultural University, Copenhagen. The Queen's Award will enable him to travel to a number of Commonwealth countries possessing rainforests which will benefit from his help in sustainable forestry. (CIFOR)

Gurdev Khush, IRRI s principal plant breeder who led the institute's rice breeding research for the past thirty years, has won another award. After receiving the World Food Prize in 1996, he was recently awarded the Dr. K. Ramiah Medal for 1997 in recognition of his contributions to global rice science. Dr. K. Ramiah was the doyen of rice scientists in India. Gurdev Khush received the award from the Indian National Academy of Agricultural Sciences. (IRRI)

A new edition of the **IRRI Rice Facts**, a booklet containing information about 41 important rice-producing countries in Asia, Latin America, Africa, Europe, Australia, and North America is now available from IRRI. Data included in the booklet are population demographics and agriculture, rice production, current rice consumption, and international rice trade. Specific information includes: estimated populations of rice-growing countries for 1995; projected populations for the years 2000 and 2025; infant mortality; life expectancy at birth; gross national product per capita, including average annual growth rate; available arable land; number of agricultural researchers; agriculture's share in the labor force; gross domestic product; average annual growth rate in the agriculture sector and rice area; daily calorie supply per capita; rice in total calorie supply; milled rice consumption per capita; total rice consumption; rice production in metric tons; area for rice production; rice production yield; area planted to modern varieties; and imports and exports for milled rice.

FAO's telephone and fax numbers have changed. The Rome headquarters' main number is now 570 plus extension. The switchboard number is 57051.

Cassava Green Mite Victory

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virtually all cassava producing areas of sub-Saharan Africa. Its attack on cassava shoots is most damaging during the dry season when its population explodes; it travels and multiplies unimpeded by rainfall mortality. "In the absence of natural controls, the mite swept through the 27 countries of Africas cassava belt," says IITA acarologist Steve Yaninek, who is leading a team of scientists at the IITA Biological Control Center in Cotonou, Benin.

Both pests originated in South America, the genetic ancestral home of cassava, where they do not cause much damage because natural enemies help suppress their populations and make their presence largely insignificant. After the mealybug had been brought under control in Africa by introducing the parasitoid *Apoanagyrus lopezi* from South America, the battleground shifted to the CGM.

Control of the pest through application of toxic chemicals was ruled out because of possible adverse effects of chemicals on illiterate farmers and the environment. Also, disease pathogens and pests tend to gradually develop resistance to most chemical pesticides over time. Moreover, most chemical pesticides are not selective and might destroy the natural enemies of the pests together with the pests.

To effectively control cassava pests and ensure better living standards for cassava farmers in sub-Saharan Africa, an intercontinental integrated pest management research project was launched several years ago. The project involves international agricultural research centers in Africa and Latin America, national agricultural research systems, and farmers in a joint effort to develop an ecologically sustainable cassava plant protection strategy. Under the arrangement, IITA is collaborating with CIAT in Cali, Colombia, the Brazilian Agricultural Research Corporation (EMBRAPA), and several African national research systems.

The United Nations Development Programme provided four-year funding for this project to help scientists at the centers and in national institutions in four West African countries (Benin, Cameroon, Ghana, and Nigeria) to work directly with farmers and extension agents. The project is supported by the International Fund for Agricultural Development (IFAD), Denmark, and Germany. The goal was to develop, test, and implement ecologically sound cassava plant protection technologies.

Great emphasis was placed on farmer participatory research, a method in which farmers and scientists work as partners in identifying local problems and finding possible solutions. The Ecologically Sustainable Cassava Plant Protection (ESCaPP) project, known as PROFISMA in Brazil, brought together a large variety of scientists from the two continents, working directly with farmers and extensionists in addressing the daily problems faced in cassava production.

After evaluating many species of predatory mites—natural enemies of CGM—over a period of ten years, EMBRAPA identified several species from Brazil that can survive in Africa. One of them, *Typhlodromalus aripo*, was found to reduce pest populations by as much as 90 percent in the dry season when pest populations are usually high; in the wet season, pest attacks are not as severe and therefore the

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LETTERS

Dear Editor,

I have scanned Volume 4, Number 2 (April 1997) of the *CGIAR News* several times, searching vainly for a reference to animals. I find this disturbing, given the pivotal role they play in increasing the nutritional status of the human population and as the most important cash crop in mixed farming systems. Perhaps some of your readers and/or writers can explain to me the reason for this extraordinary situation.

The livestock component of the farming system is the major source of cash flow in an annual financial cycle that may experience only one, or in favorable environments perhaps two, major injections from the sale of a crop, injections which are usually threatened by natural disasters that can eliminate all or part of the crop near harvest time. (Animals are consequently also an important avenue of risk management.) Cash flow from animals can be regulated by the choice of product, e.g. eggs and milk provide short-term continuous cash flows, and various forms of meat production can provide short- (chickens), medium- (pigs and small ruminants) and long- (large ruminants) investment/return opportunities for smallholder farmers. The choice of livestock/product can be tailored to the feed resources that are available to the system in different time frames offering flexibility as well as security.

There are many farmers in developed countries who owe their present existence to the sale of eggs during times of drought and other hardship. Eggs could do for the cash flow and living standards of some smallholder farmers what milk has done in parts of India. Yet eggs are often underrated in the greatly underrated contribution of livestock to agricultural development.

There are a number of other important elements to the role of animal agriculture that I cannot elaborate here, but which need to be aired and understood.

My plea is that your newsletter strive for a more appropriate balance between the sources of our food and the relative importance that animals assume in the alleviation of poverty and the well-being of smallholder farmers in developing countries.

John E. Vercoe
Agricultur I FAO Consultant

Dear Mr. Vercoe,

Your critical analysis of *CGIAR News* 4/2 of April 1997, is highly appreciated. I agree with your emphasis on the importance of animal production in farming systems, the farm economy, and human nutrition. In the nine issues of *CGIAR News* thus far published, eight articles have dealt with livestock, dairying, forages, and pastures. Two more articles are in the pipeline.

Although the CGIAR research mandate does not include poultry and pigs—because there are many alternative suppliers of research products for these two categories—I thank you for drawing our attention to the need to augment the newsletter's coverage of CGIAR research on large and small ruminants, and related sectors.

Heinrich von Loesch
Editor

Unsafe Application of Pesticides and Dangerous Old Stocks

The technology used to spray pesticides in most developing countries reflects technical standards of 40 years ago, resulting in pesticide waste and environmental damage, says FAO, calling for the adoption of minimum standards for the safe and efficient application of agrochemicals through good quality equipment and better training of farmers. In addition to problems of unsafe application, the large amounts of unused pesticides stocked in developing countries pose a serious threat to the environment and public health.

According to FAO, farmers and equipment operators have insufficient knowledge about pesticides and correct methods of application. Extension services rarely have technicians with any specialized knowledge of application technology. "In many countries, the only specialists offering advice to farmers on application technology, handling, and calibration of their equipment are representatives of pesticide companies," says Theodor Friedrich of the FAO Agricultural Engineering Branch. "Many farmers still believe in high volumes, high pressure, and high doses as the most appropriate way to apply pesticides."

In many countries, much of the spraying equipment is in extremely poor condition, Friedrich noted. Nozzles are normally not replaced and are even enlarged on purpose to achieve higher flow rates.

In Pakistan, according to FAO, about 50 percent of applied pesticides are wasted due to poor spraying machinery and inappropriate application. Many farmers have not been trained in safety aspects, and indiscriminate use of pesticides resulted in groundwater pollution.

In India, high levels of pesticide residues in food crops, compared to the world average, are reported. According to FAO, this is an indication that pesticides were used improperly. Although India has national standards for spray equipment, which are followed by the major manufacturers, there are still many small manufacturers serving local needs that do not comply with quality standards.

In Thailand, farmers so far have paid little attention to the proper use of pesticides, according to surveys. Training on spraying equipment has been insufficient. A study in Indonesia reported that 58 percent of manual spray equipment leaked. In Malaysia, the lack of training, the improper maintenance of spraying equipment, and insufficient protective clothing are contributing to pesticide poisoning among spray operators. Pesticide residue in water is primarily due to excess pesticide use by farmers.

A study by scientists of the International Rice Research Institute and the University of the Philippines reports farmers can seriously damage their health when pesticides are not handled safely. Adopting integrated pest management practices is one way rice farmers can minimize their pesticide use, thus reducing production costs and health hazards. Photo by R. Cabrera, IRRI

A report on Vietnam said that the supply of safe spray equipment was limited mainly due to the absence of national legislation and standards and a lack of training of operators. In the Philippines, sprayer leakage is very common. The majority of farmers and equipment operators never receive any formal training prior to their first contact with pesticides and application equipment.

In Colombia, flowers are sprayed weekly with up to 6,000 liters per hectare, and in Brazil application volumes of 10,000 liters/hectare in orchard crops have been reported. Application volumes of that kind cause run off and lead to soil and groundwater contamination. For efficient pest control with appropriate technologies less than 10 percent of these volumes would be more than enough.

"Technology allowing safe and efficient application of pesticides exists today and should be part of integrated pest management. However, the application depends on the technical capacity, and the economic and cultural background of a country," Friedrich said. "To improve pesticide application, the introduction of good, standard quality equipment and operator training is essential and should be part of Integrated Pest Management."

He said that farmers could benefit from safe and more efficient pesticide application, saving large quantities of pesticides and money while achieving better pest control. The commercial sector could earn by providing technology, services, and spare parts.

FAO has developed "Guidelines for the Basic Requirements for Pesticide Application Equipment" and "Standards for Pesticide Application Equipment," including test procedures. FAO suggests that incentives for improved equipment quality should be created. A certification system could be introduced on a voluntary basis by manufacturers using the certificate as a quality trademark and for sales promotion.

FAO estimates that developing countries are holding stocks of more than 100,000 tons of obsolete pesticides, 20,000 of which are in Africa. Many of these chemicals are so toxic that a few grams could poison thousands of people or contaminate a large area. Among the highly toxic and persistent substances are DDT, Dieldrin, and HCH (Hexachlorocyclohexane). Most of these pesticides are left over from

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World's Dryland Farmers Need New Agricultural Technology

'Green Revolution' Never Reached Them

For a wide swath of arid and semi-arid countries holding one-fourth of the world's population, CGIAR scientists are developing new breeds of crops and animals that grow faster and stronger, need less water, and are genetically selected for high levels of nutrition.

The results, which will revolutionize farming in dry parts of Africa, the Middle East, Asia, and Latin America, have produced plants on which animals can graze, and which then regrow for harvesting; a pigeonpea that sprouts to maturity in 110 days instead of 180; and sheep that thrive on crop residues—stalks and roots left over after harvest.

An estimated 1.6 billion people currently live in developing countries and regions affected by insufficient rainfall. Approximately half of the workforce earns its living in and from agriculture

"Given the prevailing water shortages, the usually hot and harsh climates, and soils degraded by erosion, deforestation and desertification, it is not surprising that the rural people in these countries constitute the poorest of the world's poor, many living on less than a dollar a day," says Ismail Serageldin, CGIAR Chairman and World Bank Vice President for Environmentally and Socially Sustainable Development.

"These huge marginal regions have not been touched by the Green Revolution which only boosted grain yields where ample water for irrigation was available. They have not attracted commercial investments in agricultural technology improvement because their markets are small and it is hard to step up productivity when water scarcity limits plant growth. A special effort must be made for these dryland farmers."

Population growth in the arid and semi-arid regions continues to be high, with national annual increases ranging from 3.6 percent in the southern Mediterranean region to 3 percent in sub-Saharan Africa, 2.1 percent in the Central Asian Republics, and over 2 percent in the Indian subcontinent. With growing populations and increasing food deficits, efforts to intensify agriculture have in many places depleted and degraded the natural resource base of agriculture to an alarming extent.

Overpumping has resulted in sinking groundwater levels. Rangelands are overgrazed because of rapidly rising stocking rates, while soils are eroded by wind and rare but heavy downpours, and often impoverished by long-term monocropping Because of rising demand for timber and fuelwood, the remaining natural forests and open woodlands have suffered badly In large areas, the natural vegetation has all but disappeared, and desert is spreading.

"The deterioration of natural resources in the dry areas, the loss of natural vegetation and its irreplaceable biological diversity urge a reformulation of the development paradigm," says Chairman Serageldin. "From forcing nature to give what it cannot give for more than a brief span of time, we must move to carefully husbanding and rebuilding natural resources. From unsustainable farming methods and livestock ranching we must move to more productive and sustainable practices. Otherwise there is no chance that the world's worst poverty and hunger will ever be abolished. The only way to reverse the trend is to revolutionize agricultural technology and resource conservation through scientific research."

Two of the 16 international research centers supported by the CGIAR are working to develop new technologies for dryland agriculture:

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Tef

by Seyfu Ketema

In cooperation with the German Institute of Plant Genetics and Crop Plant Research, IPGRI is publishing a series of monographs promoting the conservation and use of underutilized and neglected crops. Booklet 12 is devoted to Tef, Ethiopia's traditional staple, a robust cereal crop that tolerates moisture stress and is the optimal ingredient of Ethiopia's delicious enjera bread. The monographs aim at "identifying constraints in the use of the crops and possible solutions, identifying possible untapped genetic diversity for breeding and crop improvement programs, and detecting existing gaps in available conservation and use approaches."[1] *The following article is based on excerpts from the booklet.*

Center of origin and diversity

The fact that several endemic and nonendemic species of *Eragrostis*, some of which are considered the wild relatives of tef, are found in Ethiopia and, in addition, the fact that the genetic diversity for tef exists nowhere in the world except in Ethiopia, indicates that tef originated and was domesticated in Ethiopia. Vavilov identified Ethiopia as the centre of origin and diversity of tef. As with several other crops, the exact date and location for the domestication of tef is unknown. However, there is no doubt that it is a very ancient crop in Ethiopia, where domestication took place before the birth of Christ.

On the basis of linguistic, historic, geographic and botanical notes, tef is assumed to have originated in northeastern Africa. The current area of cultivation is probably not the initial one of domestication; domestication probably occurred in the western area of Ethiopia, where agriculture is precarious and semi-nomadic.

Geographic distribution

Most of the Ethiopian farmers use traditional landraces of tef and these are distributed all over the country. Local cultivars

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[1] Seyfu Ketema, Biodiversity Institute, Addis Abeba, Ethiopia 1997 Tef, *Eragrostis tef* (Zucc) Trotter Promoting the conservation and use of underutilized and neglected crops 12 Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome, Italy.

Tef

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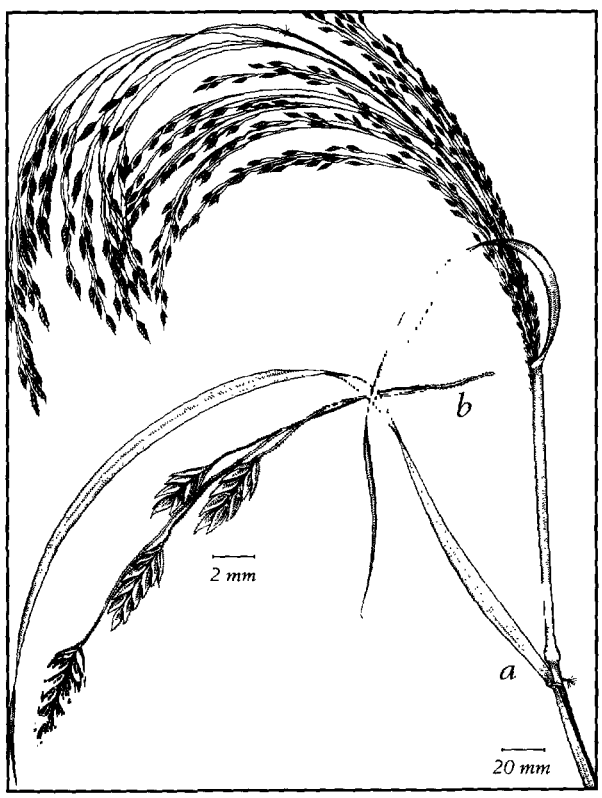
such as Gea-Lamie, Dabi, Shewa-Gimira, Beten and Bunign, which are early maturing varieties (<85 days), are widely used in areas that have a short growing period due to low moisture stress or low temperature. The same varieties are also used in areas with adequate rainfall and where double cropping is practiced. In the highly productive and major tef-producing regions of Gojam and Shewa, and in other regions where environmental stress is not severe, the local cultivars such as Alba, Ada and Enatit are used. Modern varieties are used in many regions but in very small areas within each region. In the regions of Gojam and Shewa, which are located in the central highlands of Ethiopia and are also the largest and major tef production areas in the country, modern varieties are used as well as traditional landraces and local cultivars.



Eragrostis tef (Zucc.) Trotter. (a) Inflorescence, (b) branch of panicle with floret. (Drawing by R. Kilian, 1986)

Properties

The composition of tef is similar to that of millet, although it contains generally higher amounts of the essential amino acids. The amino acid composition of tef is excellent, its lysine content is higher than that of all cereals except rice and oats, it has good mineral content and its straw is nutritious.

Uses

In Ethiopia, tef is traditionally grown as a cereal crop. The grain is ground to a flour which is mainly used for making a popular pancake—like the local bread called *enjera*—and sometimes for making porridge. The grain is also used to make local alcoholic drinks, called *tela* and *katikala*. Tef straw, besides being the most appreciated feed for cattle, is also used to reinforce mud and plaster the walls of tukuls and local grain storage facilities called *gotera*. Tef grain, owing to its high mineral content, has started to be used in mixtures with soybean, chickpea and other grains in the baby food industry.

Enjera made from tef is traditionally consumed with *wot*, a sauce made of meat or ground pulses like lentil, faba bean, field pea, broad bean and chickpea. The traditional way of consuming tef with *wot* provides a well balanced diet.

Conservation

The Plant Genetic Resources Centre of Ethiopia (PGRC/E), now called the Biodiversity Institute, is actively engaged in collecting, conservation and characterization. Utilization of the germplasm for the tef improvement program is mainly done in cooperation with the Institute of Agricultural Research. Currently the PGRC/E has a total of 3842 accessions of tef out of which 187 accessions are repatriations, 357 selections, 1310 accessions collected by other institutes and 1988 accessions collected by the PGRC/E.

Breeding activities

Applied breeding work to improve tef included direct selection from the landraces and intraspecific hybridization, while at the basic research level, investigations were made in the area of biotechnology. The applied research attempts in the areas of mutation and interspecific hybridization programs have not yet contributed to the development of improved cultivars.

On the other hand, the direct selection from the landraces and the intraspecific hybridization program which was employed to effect gene recombination were successful in developing several improved cultivars of tef with desired traits. The improved cultivars developed include: cultivars that have high grain yield with wide or specific adaptation, cultivars with acceptable high grain quality, and early maturing, high-yielding varieties. All the improved cultivars were accepted by farmers and currently are in production. Direct selection from the landraces, mutation breeding and intraspecific hybridization were tried for developing lodging-resistant varieties. However, so far no success has been achieved.

Lodging is still one of the production constraints and therefore the breeding program has the development of lodging-resistant varieties as one of its objectives. Other production constraints are: low-yielding cultivars, low moisture stress resistance, waterlogging, frost, weeds, poor soil fertility, diseases and insects. Generally, the tef crop improvement program attempts to solve these production constraints through a multidisciplinary research approach. Specifically, the breeding program should overcome the problems of low grain yield, and also develop cultivars that are resistant to low moisture, waterlogging and disease as there is a wealth of genetic diversity within tef

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Tef

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germplasm.

Ecology

Tef is adapted to a wide range of environments and is presently cultivated under diverse agroclimatic conditions. It can be grown from sea level up to 2800 m asl, under various rainfall, temperature and soil regimes. However, according to experience gained so far from national yield trials, conducted at different locations across the country, tef performs excellently at an altitude of 1800-2100 m, annual rainfall of 750-850 mm, growing season rainfall of 450-550 mm and a temperature range of 10°C-27°C. A very good result can also be obtained at an altitude range of 1700-2200 m and growing-season rainfall of 300 mm.

Agronomy

In Ethiopia, tef is cultivated in much the same way as wheat and barley. Depending on the location and maturity period of the cultivar, it is grown during the main growing season between July and November, and also during the small rainy season between March and June. It is mainly cultivated as a monocrop, but occasionally under a multiple cropping system.

Limitations of the crop

The small size of tef seed poses problems during sowing, and indirectly during weeding and threshing. At sowing, the very small seed size makes it difficult to control population density and its distribution. This remains true whether one broadcasts the seed by hand, uses a broadcaster or a seed driller.

The uneven plant stand after germination has an impact on nutrient use, efficiency of the crop and crop yield. Owing to the scattered plant stand, farmers find it difficult to use mechanical weeding implements and are forced to either hand-weed or to use chemical herbicides.

Landraces and current cultivars give low yield. At present the national average grain yield of tef is 910 kg/ha. Improved varieties of tef give a grain yield of 1700-2200 kg/ha on farmers' fields and 2200-2800 kg/ha on research-managed large farms. However, no comprehensive study has been conducted to assess the yield potential of the crop.

Prospects and research needs

Ethiopian farmers prefer to grow tef because of the following advantages:

- It can be grown in areas experiencing moisture stress.
- It can be grown in waterlogged areas and withstands anaerobic conditions better than many other cereals, including maize, wheat and sorghum.
- It is suitable for use in multiple-cropping systems such as double, relay and intercropping.
- Its straw is a valuable feed during the dry season when there is an acute shortage. It is highly preferred by cattle over the straw of other cereals and demands high prices in the markets.
- It has acceptance in the national diet, has high demand and high market value and hence enables farmers to earn more than with other crops.
- It is a reliable and low-risk crop.
- In moisture-stress areas, farmers use it as a rescue crop. For example, around Kobo and Zeway, which are areas with low and erratic rainfall, farmers first plant maize around April. If this fails after a month or more because of moisture stress or pest problems they plough it under and plant sorghum. If this also fails after a month or more then they sow tef as a last resort, which often survives on the remaining moisture in the soil and yields some grain for human consumption and straw for feed.
- It is not attacked by weevils and other storage pests and therefore is easily and safely stored under local storage conditions. This results in reduced post-harvest management costs.
- Compared with any other cereals growing in Ethiopia it has fewer disease and pest problems.

China Modernizing Grain Transport

Chinese port, grain and transportation authorities are planning a shift from burlap to bulk that aims to modernize the grain transport system with the addition of thousands of new trucks, ships and railcars, Reuters reports. China is awash in grain after two years of record harvests, but much of that cereal is languishing in production areas, unable to find its way to market because of a creaky transport system, officials said in recent interviews.

China's main method of moving grain throughout the country was the cheap but labor-intensive and inefficient burlap sack, said Alan Piazza (World Bank), who follows Chinese grain issues. "China has something like three billion burlap bags." Piazza told reporters. "The government has not shown itself to be agile in manipulating reserves."

The World Bank was lending China more than $300 million to support a project to shift away from transporting grain in sacks to moving it in special bulk railway cars, ships and trucks, Piazza said. Chinese dock workers took 10-14 days to fill a 30,000-ton ship with sacks of corn, while a bulk loading system could fill a 60,000 ton ship in 36 hours. "It no longer makes economic sense," he said.

(Agency report in *World Bank Development News*.)

Free Internet Link for NARS

National agricultural research institutions that have access to e-mail facilities can now be represented, at not cost to them, by a home page on the World Wide Web. This innovative service was announced by the International Service for National Agricultural Research (ISNAR). The service will facilitate inter-institutional communications and enable the national systems to disseminate research information.

ISNAR will work with the developing country agricultural research institutions to develop the home pages and then link them with ISNAR's own Web site. An associated electronic connection via e-mail will enable interested parties to get in touch with the respective institutes. As such, the service will provide the research institutes with greater visibility globally, as well as greater accessibility electronically via e-mail.

ISNAR decided to develop the Web site because of a growing number of requests for information and services from developing countries. ISNAR will also use the Web site to allow many of its latest publications available worldwide to be read, downloaded, and printed.

Another aim is to establish and moderate e-mail discussion forums on topics related to agricultural research. Management of biotechnology research and agricultural research priority setting are the first two active forum topics. National agricultural research institutions throughout the world can apply to take part in the ISNAR Web page project or discussion forums by contacting ISNAR@CGNET.COM. ISNAR's publications catalog and other institutional information can be accessed at http://www.cgiar.org/isnar. (ISNAR)

Largest Genetic Resources Database Now On The Internet

SINGER, the System-wide Information Network for Genetic Resources, is an Internet database of over 600,000 samples of crop, forage, and tree germplasm of major importance for food and agriculture. Combining the genetic resources information of 12 of the 16 international agricultural research centers of the CGIAR, it's the largest of its kind in the world and can now be accessed on the World Wide Web.

SINGER allows searches from anywhere in the world for information on the identity, origin, characteristics, distribution, and other information pertaining to the genetic resources in these individual Center collections. Because of SINGER, those seeking information don't have to browse through computers in a dozen countries to extract the data. What they explore is a composite database of genetic resources data from the 12 Centers.

SINGER users with Internet access and an ordinary World Wide Web browser can search for germplasm information in the vast database. By picking from lists of options, they can narrow searches; for example, by region or by crop to meet specific needs.

A large range of passport, germplasm transfer, collecting mission, and characterization descriptors are available to search. Data can be viewed in several formats and saved for local use. The information is used by scientists to breed high-yielding, drought-, disease, and insect-tolerant or resistant food plants. In addition, the plant germplasm described in the database—which is collected, catalogued, and stored in the various Centers—is made available without cost to plant breeders in developing countries.

Significantly, SINGER is designed to allow each Center to retain autonomy and control over its own data. Updates such as additions and changes are made at the Centers and are immediately integrated into the combined database via a private worldwide data communication network.

SINGER is located at CGNET Services International, Menlo Park, California. CGNET provides international research and development locations in more than 100 countries with e-mail, fax, and Internet connectivity.

SINGER can be accessed on the World Wide Web at. http://www.cgiar.org/singer. CGNET e-mail is: postmaster@cgnet.com; fax is 415-325-2313.

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Agriculture Fast Facts

- Agriculture represents about 30% of GDP in Africa and South Asia; about 20% in East Asia & Pacific; and about 10% in Central Asia, Latin America & Caribbean.
- Agriculture's share of GDP for methodological reasons is probably understated in most developing countries because of rural urban differences in the purchasing power of the national currency.
- The 1980-1993 agricultural growth rate was about 4% in Middle East & North Africa, and East Asia & Pacific; about 3% in South Asia, about 2% in Latin America & Caribbean and Africa; and negative in Central Asia.
- Agricultural products account for 30% of exports in Africa, Latin America & Caribbean; about 20% in South Asia and East Asia & Pacific, and 5% in Middle East & North Africa. (Agriculture's share in exports is markedly higher in several regions if oil exports are excluded)
- Rural people make up 70% of total population in South Asia, Africa, and East Asia & Pacific; about 50% in Middle East & North Africa; and about 30% in Central Asia, Latin America & Caribbean.
- Of the world's 1.3 billion people living in poverty, 70% live in rural areas.
- Of the 800-900 million undernourished people in the world, the majority is again living in rural areas.
- Rural growth is widely shared, with private and competitive agriculture and agribusiness as the main engine of growth. Investments in agriculture therefore achieve a strong multiplier effect which stimulates rural and urban economies alike. The historical take-off of newly industrialized economies on high growth trajectories was usually preceded by a phase of vigorous agricultural growth.
- Family farms and non-farm enterprises offer ample remunerative employment to men and women. Only the rural economy based on agriculture has the capacity to absorb rapidly growing age groups of job entrants.
- Agriculture is the prime warden of the environment. Unless racked by poverty and hunger, farmers manage soils, water, forests, grassland, and fisheries in a sustainable manner. Diminishing rural poverty means improving conservation of natural resources.

(World Bank. From Vision to Action in the Rural Sector, 1996, and other sources)

The Importance of Livestock

Livestock have an image problem in the developed world. They are blamed for everything from global warming to increasing heart disease. Britain's 'mad cow disease'—or bovine spongiform encephalopathy—hasn't helped. Livestock are seen as wasteful, growing fat on grain that people could eat and polluting the environment with their faeces, urine, and the gases they give off. But these charges are not true of livestock in the developing world.

True, ruminants produce methane gas, one of the 'greenhouse gases'—but methane from ruminants accounts for only 2.5 percent of the total greenhouse gases. Pastures grown to feed livestock take carbon dioxide out of the atmosphere, tying it up in plant material above and below the ground, just as forests do.

True, eating too many animal products may increase the risk of heart disease - but this is a problem of the developed world, not the developing world. People in developing countries generally eat much less meat than those in the developed world, and the meat they eat is less fatty. Indeed, recent studies from Kenya, Egypt and Mexico show that children who do not get enough meat and milk in their diets may grow up physically and mentally compromised.

Livestock play a vital role in the agricultural and rural economies of the developing world. Not only do they produce food directly, they also provide key inputs to crop agriculture. Most farms in the developing world are too small to justify owning or using a tractor, and the alternatives are animal power or human labor.

For many smallholder farmers, livestock are the only ready source of cash to buy inputs for crop production - seeds, fertilizers and pesticides. Livestock income also goes towards buying things the farmers cannot make for themselves. And that includes paying for school fees, medicine and taxes. Income from cropping is highly seasonal. In contrast, small stock, with their high rates of reproduction and growth, can provide a regular source of income from sales. So can milk and milk products like butter and cheese. Larger animals such as cattle are a capital reserve, built up in good times to be used when crops are poor or when the family is facing large expenses such as the cost of a wedding or a hospital bill.

In the past, farmers could restore the fertility of their land by letting it lie fallow for several years or longer. But as population pressure increases, fallow periods decline or even disappear and different ways of maintaining food production are needed: enter the animal.

Animals are a crucial link in nutrient cycles, returning nutrients to the soil in forms that plants can readily use. They can bring nutrients from pasture and rangeland and concentrate them on crop land through their manure and urine. The animal manure and urine that people in the developed world see as pollutants are vital fertilizers in the developing world. Few smallholders can afford enough mineral fertilizers. Animals give farmers a reason to plant legumes as pastures and cover crops that protect the soil and restore its structure and fertility. According to a Winrock report in 1992, 'The greatest threat to [the African rangelands] comes from human populations and expansion of cultivation. There is no solid evidence linking livestock to this process [desertification].'

Increasing the productivity of livestock systems and mixed crop-livestock systems motivates farmers to protect their rangelands and use them sustainably for raising livestock rather than putting them to the plough.

Productive livestock can add value to 'idle' land. Already, in many parts of the world mixed crop-livestock systems are the norm, but the importance of the livestock component has been overlooked. Even the language we use tends to reinforce this. When we talk about the non-grain parts of cereal crops, we tend to use terms like 'crop residues' or 'by-products'. Yet in many farming systems, such as the barley-sheep system of the drier parts of West Asia and North Africa and the tef-based system in the Ethiopian highlands, the farmers value these 'by-products' as much as, if not more, than the grain. 'Improved' varieties or production packages that overlook the feeding value of these 'residues' will find little favor with the majority of farmers.

Intensive animal production in the developed world uses resources that could serve direct human uses—grain that could be eaten by people, land that could produce food crops, electricity that could illuminate and heat people's homes. But in the developing world livestock add value to resources that would otherwise go to waste. Marginal land that cannot, and indeed should not, be plowed. Straw, stovers, groundnut haulm, household wastes, all go to feeding livestock in smallholder systems. Cassava peel, for example, feeds goats in humid West Africa. In Syria farmers allow weeds to grow in their cereal fields and then 'rogue' them to

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(ILRI)

When You Have A Dairy Cow...

Njeri Kariuki starts her day at sunrise in the highlands of Kenya with the mainstays of her family, two cross-bred cows. As head of the household now that her husband has taken a job in the city, Njeri is responsible for their five children, her husband's mother, and the less than one acre of land they call home. More than half of the smallholder dairy farmers in East Africa are women whose husbands are working in cities or away from home.

Njeri's farm system works in a cycle. Her cows, which are the major capital asset on the farm, are the drivers of the system. They provide milk to drink and sell, manure to fertilize the crops, and calves to sell or replace the cows when they get old. Njeri uses the manure her cows produce to fertilize the Napier grass forage she grows to feed the cows. She also uses it on the maize and sweet potatoes she grows to feed her family and some tea she has planted as a cash crop. In addition, she feeds crop wastes—the leaves of the sweet potato plants and the stalks of the maize plants—to her cows.

Njeri can only squeeze five liters of milk a day from each of her cross-bred cows. Other dairy farmers in her district get two to three times this quantity, but she can't produce or buy enough good quality feed to improve her cows' milk production. She and her family drink about a third of the milk her cows produce and she sells the rest to neighbors and the local milk cooperative. It seems there is never enough milk for her family's needs, just as there is never enough feed for her cows.

Nevertheless, Njeri is basically satisfied with her enterprise. "When you have a dairy cow," she says, "you have money in your pocket, food on the table, and protection against failing rains and rising prices."

Like farmers worldwide, Njeri is concerned about rain. When will the long rains begin? Will they be enough to sustain her Napier grass and maize? Will they be too strong and wash the soil from her fields? But in the highlands of Kenya, Njeri is nearly certain that the rains will come. And she is sure the land she cultivates and grazes her livestock on this year will still be hers next year.

That's not so across the large tracts of semi-arid Africa and Asia where year-long droughts are likely to occur one year out of three, and two-year droughts are likely to occur every decade. When this happens livestock producers have only one choice, to move. When the rains fail in one place, herding livestock producers—known as pastoralists— simply walk with their animals to other areas, near or far, where the rains and forage are more plentiful. In areas of low and highly variable rainfall, mobility is an essential part of how they continue to produce livestock.

(ILRI)

To be able to move, livestock producers must have access to a variety of rangeland patches, and to what researchers call fallback resources—places where animals can graze and drink during the driest seasons of the year and the driest years. The system of rights and rules governing the use of land—which can be based on custom or actually made into law—must take into account this need for mobility and permit access to fallback resources of water and feed.

Villages, and the long-standing societies within them, normally develop systems of rights and rules that provide the people who live there the assurance they will have access to a well and discarded plant residues. However, there is room for conflict where more-mobile and less-mobile systems collide.

"There's always concern and controversy about how land is held, especially in Africa," says Brent Swallow, an agricultural economist at ILRI. "Those concerns and controversies are greatest in the boundary areas where mobile livestock production and mixed crop-livestock farming systems co-exist—competing at times, complementing other times. The possibilities for conflict and controversy are higher still where people, livestock, and crops share the land with wildlife."

Swallow is compiling and analyzing case studies of competing land use in Niger, Ethiopia, and Zimbabwe in collaboration with some of his colleagues from ILRI, scientists from IFPRI, and local researchers from the national agricultural research services in those countries. From these case stories the research team develops models and policy recommendations for decision makers in other areas of Africa.

According to Swallow, "If you try to understand the needs and interests of the different types of farmers, the risks that they face, and the impacts of various public policy options upon them, then you can better assist decision-makers who must try to balance those needs and interests."

It's a process of learning, bridging, and integrating that can't happen in isolation from the vagaries of the real world. At ILRI, it doesn't.

Whether it's in crop-livestock systems directly, or in component parts like disease control or vaccine development, ILRI ecologist Robin Reid says one paradigm has shifted dramatically: "It's not just 'people' and

then everything else," she says. "People are not considered separate from their environment anymore. They are being recognized as an integral part of the environment, subject to, and part of, all the shifts and impacts that occur."

Anticipating improved control of the tsetse fly and African animal *trypanosomiasis,* a lethal cattle and small ruminant disease, newly-formed multidisciplinary teams are already looking at what will happen as the land currently under trypanosomiasis risk becomes more hospitable for farming. How great are the potential economic benefits? What will happen to the land, the trees, and the biological richness when more cattle, sheep and goats can live well in the region? What will happen in communities that now must cope with different pressures on natural resources and different land-use patterns?

"All along, we must listen to the user," says Guy d'Ieteren, ILRI animal scientist. "We do research right at the ground level. The path from farm level research to the policy level is very natural. The linkages between the biological efforts and the social and economic impacts become obvious if you follow them."

Many farmers, according to Reid, are acutely aware of environmental concerns. They pick up subtle feedback signals from the environment earlier than many. After years of daily interaction, they have an inherent understanding of how the environment works. But poverty forces them to do things for survival in the short term that cause problems in the long term. They understand, but can't do anything about it.

"These multidisciplinary research teams I work with are all focused on solving problems at one level or another," says Reid. "What we try to do in coordination with this problem solving process is identify environmentally sound production practices farmers can use within the conditions of their world."

Success requires understanding where all the parts of the puzzle fit. And success is critical because this ILRI research team is working at one of the most vulnerable boundaries of all: the boundary where intense poverty meets a fragile environment.

(ILRI)

Past & Upcoming

CGIAR System Review The ongoing CGIAR System Review exercise (the third since the CGIAR's inception in 1971), covering all aspects of the CGIAR including the centers, is chaired by a distinguished panel led by Maurice Strong who had participated in the Bellagio meetings that led to the establishment of the CGIAR. Later, he chaired the 1992 Rio de Janeiro Earth Summit and is currently Special Adviser to the President of the World Bank.

The System Review Panel has been asked to examine all aspects of the CGIAR System and three specialist panels covering science, strategy and structure, and governance and finance have been appointed. The Panel is conducting its examination with a broad, forward-looking perspective, focusing, in particular, on the future role of the CGIAR system within the rapidly changing global scientific, communications, and institutional settings and arrangements.

In its work, the System Review Panel pays particular attention to the evolving capacities of national agricultural research systems in developing countries, NGOs, and the private sector; the comparative advantages of various actors; the organization and management of research; and the need for strengthening research partnerships.

Mahendra Shah, Senior Advisor (Sustainable Development and Environmental Conservation) has been appointed Executive Secretary of the System Review. The Secretariat is located at the World Bank in Washington, D.C. (Phone 202-473-0551; Email: cgreview@aol.com).

The System Review Secretariat is setting up an Internet website to facilitate an open forum discussion/suggestions for interaction with all partners and constituents. The new website can be found at http://cgreview.worldbank.org

Biotechnology and Biosafety The 5th Annual World Bank Conference on Environmentally and Socially Sustainable Development "Partnerships for Global Ecosystem Management: Science, Economics and Law" will be held in Washington, October 6-8, 1997. Following this event, a forum on "Biotechnology and Biosafety" will be held during October 9-10 with a view toward exploring both the promise of biotechnology and potential risks, and grounding public debate on the basis of scientific evidence. The event is being co-sponsored by a range of international institutions, including the American Association for the Advancement of Science (AAAS), International Council of Scientific Unions (ICSU), International Food Policy Research Institute (IFPRI), Smithsonian Institution, Third World Academy of Sciences (TWAS), U.S. National Academy of Sciences (NAS), Union of Concerned Scientists (UCS), and specialized agencies of the United Nations (UNDP, UNIDO, UNEP, and UNESCO). Featured speakers include Nobel laureates Henry Kendall, Chairman, UCS, and Werner Arber, President, ICSU.

Oversight Committee: The next meeting will be held in October 1997, in conjunction with ICW97. There may be an additional meeting in September 1997, depending on the outcome of the first meeting of the System Review Panel.

Private Sector Committee: The next meeting will be held in October 1997 in Washington DC. The Committee has established a Working Group to further develop the idea of a possible High-Level Private Sector Conference focusing on biotechnology issues, tentatively planned for early-1998.

External Reviews: The following external reviews will be completed by MTMPS: CIFOR, CIMMYT, IFPRI and IRRI.

IITA—30th Anniversary: On 24 July, the International Institute of Tropical Agriculture celebrated its 30th anniversary. IITA had been established in 1967 by the Federal Government of Nigeria as a non-government international agricultural research and training center with responsibility to improve food crops and farming systems in the humid and subhumid tropics. IITA was funded by the Rockefeller and Ford Foundations until 1971 when the CGIAR took up the responsibility of arranging funding for IITA and the other centers in the system.

Biotechnology in the CGIAR

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would run the risk of adding more technologies that are irrelevant to the majority of small-scale producers and to sustainable agriculture.

National agricultural research systems (NARS) should play a lead role in using the technologies developed through biotechnology for the benefit of the poorest people. Strengthening developing country access to biotechnology and its benefits was seen as an important means of encouraging developing countries to continue to support open access to indigenous genetic materials.

The CGIAR must recognize the social, cultural, and legal implications, in addition to the technological implications, of employing biotechnology. It is important to get the support of, and a sense of direction from, society at large.

Examining DNA structures. (CIAT)

Before the CGIAR becomes more involved in biotechnology, it must carefully assess and clarify its position on a range of critical issues and develop a strategy on how to proceed. First, the CGIAR must assess the need and scope for an expanded CGIAR effort, the CGIAR's comparative advantages globally, its current strengths and weaknesses, and whether it will move forward in an *ad hoc* fashion, with each center making individual arrangements with partners as is currently the case, or whether there will be collective agreement on a set of guidelines that the centers will follow.

Second, the CGIAR must assess issues pertaining to the use, risks, and funding of biotechnology, biosafety, intellectual property rights, equity, poverty, ethics, and public opinion. The importance of the CGIAR clearly positioning itself in the global agricultural research system on these issues was emphasized. The CGIAR was urged to take a more proactive stand, to develop its own clearly articulated strategy, given the rapid developments related to these issues in international fora.

The global trend toward limiting access to genetic resources and scientific knowledge, in contrast to former free availability, will have very significant implications for the CGIAR, as it continues to produce international public goods in an environment that is increasingly characterized by proprietary technology and access regulated information. It was felt to be critical that the CGIAR work to ensure the protection of international public goods, and to facilitate access to new technological products and techniques to benefit the poor in developing countries.

For the CGIAR to play a significant role in biotechnology research globally, stronger research alliances on biotechnology within the CGIAR and between centers and other institutions need to be developed. The CGIAR must explore opportunities for new partnerships, strategic alliances, and joint ventures with a variety of partners, including NARS, Advanced Research Institutions (ARIs), the private sector, and NGOs.

The CGIAR was urged to draw on the existing experiences and partnerships among the public and private sectors, NGOs, and producers currently working in the interest of the development and promotion of biotechnology. As well, a participatory, bottom-up approach involving all stakeholders, particularly NARS and farmers, was advocated for problem identification, priority setting, and the development of solutions for the problems of small-scale farmers. The CGIAR should be a bridge builder between small-scale farmers, especially women, and high-level, demand-driven research.

The CGIAR currently invests about $30 million in biotechnology research annually. An expanded CGIAR effort in biotechnology would necessitate that CGIAR investments in biotechnology research be increased by a significant amount, a multiple of the current allocation to be realized over a period of several years. Resource requirements must be carefully considered.

The CGIAR should build on existing capacity and expertise and prioritize to focus on those areas which will provide maximum benefits to stakeholders and in which the CGIAR can play effective partnership roles, without entering conflicts. Although modest compared to total spending globally on biotechnology research, the CGIAR's investments must be deployed creatively to leverage investments by others in the public and private sectors. Where specific projects can be contracted out, this should be done. Collaboration with universities or public research institutions may provide low cost options which minimize the perception of private sector interest conflicts. The CGIAR must look more creatively at collaboration with NARS, to draw on other public sector resources at the local level.

As biotechnology is one tool among many available for use by the centers, biotechnology applications should be integrated within the programs of the centers, rather than treated as a special initiative or program.

The CGIAR was urged to help to promote the establishment of appropriate regulatory mechanisms consistent with national biosafety requirements in developing countries. The CGIAR should develop its own biosafety protocol, while awaiting the development of an international protocol on biosafety by the Convention on Biological Diversity.

It was recommended that the CGIAR assemble portfolios of intellectual property across the system as

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Biotechnology in the CGIAR

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a basis for enhancing the CGIAR's position in negotiating access to enabling technologies, many of which are held by the private sector. It was also noted that the CGIAR may need to consider the desirability of retaining or creating a legal facility to negotiate on behalf of the centers and partners with the private sector.

The Group welcomed proposals calling for the establishment of two *ad hoc* expert panels under the auspices of the Technical Advisory Copmmittee (TAC) to address general issues in biotechnology and proprietary science and technology. It was agreed that TAC should play a key role in the panels and in the consultation process.

The importance of drawing on appropriate expertise for representation on the panels, both in terms of highly specialized scientific and legal expertise as well as representation from society at large, to enable the panels to distill and focus on the issues of greatest relevance to the CGIAR, was emphasized.

The process of how members of the two panels would be selected was raised. A recommendation was made that suggestions of suitable candidates for each panel should be provided, followed by a brief consultation with key stakeholders on the nominations received, and finally a broader consultation through the standing committees, prior to the appointment of the two panels. It was noted that the panels would be similar to other CGIAR stripe reviews, which operate under the auspices of TAC, but have their own persona. The importance of having widespread ownership in the selection process and in the subsequent outputs of the panels was emphasized.

It was agreed that the panels should incorporate the results of the Gentic Resources Policy Committee workshop on ethics and equity, and the Chairman's planned consultation on biosafety. The efforts should also draw on available expertise within the system, including the special unit in ISNAR which deals with the management, safety, and intellectual property aspects of biotechnology as they apply to NARS.

Given the importance of intellectual property issues to biotechnology, TAC was urged to organize the meetings of the two panels back-to-back, to enable interaction and each panel benefiting from the other panel's deliberations.

On the terms of reference for the proprietary science and technology panel, suggestion was made that the expert panel look at options for the CGIAR and its centers to access legal capability, rather than the CGIAR building a legal capability within the system.

The Private Sector Committee indicated its support of the terms of reference of each panel, yet cautioned that they were ambitious. The CGIAR was urged take a pragmatic approach, both related to the terms of reference of each panel, as well as in the selection of panel members.

The NGO Committee urged the CGIAR to include representation from society at large, in particular on the panel on proprietary science and technology that will be addressing ethical and equity questions, as these issues transcend scientific and technical dimensions. The CGIAR must ensure that key groups are not excluded, as they have a tremendous capability to mobilize public opinion and political support in a direction that might be counteractive to what the CGIAR wants to do.

The Group reached agreement on the following points:

- The CGIAR will move ahead to increase the conduct of biotechnology research carried out by the centers.
- Two specialist panels will be created under the auspices of TAC to review biotechnology issues and to deal comprehensively with intellectual property rights issues, respectively. The panels will be constituted and will meet prior to International Centers Week (ICW97) in October 1997.

Durum Wheat x Barley Hybrid

Tritordeum (XTritordeum Ascherson et Graebner) is the amphiploid derived from the cross between a South American wild barley (Hordeum chilense Roem. et Schult.) and wheat Because this amphiploid has shown the agronomic characteristics of a new crop, we decided to evaluated the possible uses of this new cereal and its role in agriculture. For this reason, in the last five years, several lines of tritordeum have been evaluated, along with some lines of durum. The results have indicated that both hexa- and octoploid tritordeum exhibit quality characteristics similar to those of bread wheat and very different to those of durum wheat. Likewise, a wide range for quality characters has been shown between the tritordeum-tested lines. Several works, also, have suggested that the H. chilense line seems be to associated with the storage proteins from both parents. Although the hexaploid tritordeum have exhibited baking properties slightly poorer that those of bread wheat, any of the lines analyzed had been improved for quality. On this basis, we think that the role of tritordeum and H. chilense in the food industry could be similar to that of bread wheat, although the end-use and potential cultivated-zone are yet to be determined.

L.M. Martin, J.B. Alvarez, M.J. Gimenez, A. Martin. Departamento de Genetica, Escuela Tecnica Superior de Ingenieros, Agronomos y de Montes, Universidad de Cordoba, Spain; Departamento de Agronomia y Mejora Genetica Vegetal, Instituto de Agricultura Sostenible, CSIC, Cordoba, Spain.

(IPGRI)

Progress in Research on Tropical Forests

Continued from page 1

invested heavily in producing its "Global Biodiversity Assessment." However, the forestry debate at Rio was so politicised that science was given a rather low profile. Some developing countries feared that "science" would mean a lot of finger pointing by northern activist groups with a very preservationist agenda. Many of the NGOs felt that science would result in an agenda dominated by the interests of the timber industry. Even in the post-Rio period, the forest debate has been highly emotional and driven more by special interest groups.

One of the first things we did at CIFOR was to bring together a group of scientists, politicians, international negotiators, and NGOs to discuss the information needs for implementing the Rio decisions on forests. This resulted in a paper presented at the FAO Ministerial meeting on forests in 1995. Since then, science has gradually achieved greater prominence in the discussions of the Intergovernmental Panel on Forests (IPF). The report of the panel that was presented to the special session of the UN General Assembly in New York in June contains a specific recommendation on strengthening and giving greater coherence to scientific efforts to understand the world's forest problems. So, at the political level we have made good progress. Now we need to translate this into greatly increased activity on the ground. CIFOR's own research has drawn on partners throughout both the developing and the developed world. This research is yielding new information which is feeding into the intergovernmental process already. I think we have got off to a good start but the intensity of effort on international strategic research on forests is still inadequate in relation to the magnitude of the problems.

Q: How best can a center such as CIFOR contribute towards the enormous challenges facing tropical forests and forest dependent people?

A: We have tried to articulate the answer to that question in our strategic plan and our medium-term plan. The strategic plan in particular was the result of a very great deal of thought and interaction with numerous partners. One of the advantages we have is that because of the Rio processes the world is reassessing its forest agenda. There is a very large number of processes going on to identify problems and look for solutions. CIFOR has to be very well connected with these efforts because they provide us with a unique input to our priority setting and, even more importantly, a very effective delivery mechanism for our products. In particular, the Intergovernmental Panel on Forests has identified a number of areas where new information is needed. This recognition comes from an intergovernmental activity and it, therefore, has international legitimacy. The IPF wants more information on the underlying causes of deforestation. It wants to know how biodiversity conservation needs can be reconciled with forest development. It is creating a demand for cost effective criteria and indicators to assess forest conditions. It is re-examining the institutional arrangements for managing forests, and has great interest in the role of the private sector and local communities. All of these things, and many others on CIFOR's current research agenda, are topics where CIFOR is producing new information. We can channel this information into the deliberations of the Commission on Sustainable Development (CSD) and it will thereby get diffused very quickly back to decisionmakers.

There are undoubted benefits to CIFOR having stronger links with the agricultural research community although this will not be with the commodity-oriented agronomists.

Q: In many respects, CIFOR's constituencies, both international and national, lie outside of the CGIAR system and its NARS partners. How do you see CIFOR serving the needs of the CGIAR as well as the global forestry community?

A: It is true that the people we meet at International Centers Week and at the global fora are not the same scientists that we are working with on a day-to-day basis. The forestry research community has been rather inward looking, and links between it and agriculture have been weak. Interestingly, this is less the case in Latin America where research is often conducted in institutes with a natural resource focus rather than a pure agriculture or forestry focus. At the moment, we are very well positioned with the forest research community. We have benefited greatly from our links with the International Union of Forest Research Organisations (IUFRO) and with FAO and its regional bodies. There are undoubted benefits to CIFOR having stronger links with the agricultural research community, although this will not be with the commodity-oriented agronomists. Perhaps the agriculturalists also need to make a move toward seeing their research in a broader natural resource context. A key role of CIFOR could be to bridge this gap and to have one foot in each camp.

Q: What is the specific role of CIFOR in relation to intergovernmental agencies such as FAO, the International Tropical Timber Organisation (ITTO), IPF, etc.?

A: As I said earlier, we have got off to a very good start with all the important international actors dealing with forests. We have always had excellent relations with FAO. We have a number of shared activities and a good flow of information with their staff in Rome. We recently formed a strategic alliance with ITTO in Yokohama to develop CIFOR's research forest in East Kalimantan as a large-scale model of science based sustainable forest management. Our policy dialogue on "forest science and sustainability" in 1994

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(CIFOR)

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provided us with a platform which gave us excellent access to the Intergovernmental Panel on Forests. We have subsequently been very involved with the IPF and its various intersessional activities. CIFOR made substantial contributions on the work on criteria and indicators and on the need for new approaches to science which was the subject of an intersessional meeting sponsored by Japan in 1996. The results of the Rio+5 Special Session of the UN General Assembly will certainly influence the way we move forward over the next few years.

Q: CIFOR is approaching its fifth year as a CGIAR center. Has your vision of forestry research needs and priorities changed significantly during this period?

A: Yes. We set out to be a "learning institution" and we learned a great deal in the first five years. We no longer believe in "silver bullet" type technical solutions to the world's forest problems. What is needed is to pull together science from a diversity of disciplines and approaches to give a more in-depth and holistic understanding of forest systems. This means that, within CIFOR, we have to maximise the interaction between all the different scientific groups. Our thinking is that the activities of each of our ten projects have to be valid in their own right. At the same time, they must contribute to an "enabling environment" which provides context and support for the other nine projects. In other words, we are committed to vertically integrated research as it has been described in the CGIAR debates on its ecoregional foci. This vertical integration means that we must have a large proportion of our scientists active in focal locations in the three tropical regions. We expect that new insights and understanding will come out of the in-depth analysis of the problems of these representative locations. Another thing that has become very clear in the last few years is that we can benefit enormously by exploiting the synergies between CIFOR's work and the work of the other CGIAR centers operating on the agricultural side of the forest frontier. Our work at the CGIAR ecoregional sites in Mbalmayo in Cameroon and Pucallpa in Peru shows great promise in this direction.

Professor Jeffrey A. Sayer is Director General of the Center for International Forestry Research (CIFOR)

Major Organizations Active in International Forestry Policy and Research

Organization	Address	Objectives	Head/Contact
International Tropical Timber Organization (ITTO)	Pacifico-Yokohama, 1-1-1, Minato-Mirai, Nishi-ku, Yokohama 220 Japan	To provide an effective framework for consultation among producer and consumer member countries on all aspects of the world timber economy within its mandate	N.C.Y. Freezailah, Executive Director
FAO Forestry Department	Via delle Terme di Caracalla I-00100 Rome, Italy Phone: 396-57053550	To conserve the world's forests, while also using trees and forests to contribute to the environmental well-being of the world's rapidly expanding population	David A. Harcharik, Assistant Director-General
International Union of Forest Research Organizations (IUFRO)	c/o Forstliche Bundes-Versuchsanstalt Seckendorff-Gudent-Weg 8 A-1131 Vienna, Austria Fax: 431-8775907	To promote international cooperation in forestry and forest product research	Jeffrey Burley, President Heinrich Schmutzenhofer, Secretary
European Forest Institute	c/o European Forest Institute Torikatu 34, FIN-80100 Joensuu, Finland Phone: 358 13252020; Fax: 358 13124393	To provide relevant information for policy-making and decision-making in European countries relating to the forest and forest industry sector, conduct research in the above mentioned fields, develop research methods, compile & maintain data concerning European forests, participate in scientific meetings, organize and participate in forest research training , publish and disseminate knowledge of its work & results	Paivinen Risto, Deputy Director
World Commission on Forests and Sustainable Development	WCFSD Secretariat Suite 405 1801 K St. NW Washington DC 20006, USA Phone: 202-4584448; Fax. 202-5220552	1. Increase awareness of the dual function of world forests in preserving the natural environment and contributing to economic development; 2. Broaden the consensus on the data, science and policy aspects of forest conservation and management, and 3. Build confidence between North and South on forest matters with emphasis on international cooperation	Emil Salim, Co-Chair Ola Ullsten, Co-Chair John Spears, Secretary
Intergovernmental Panel on Forests	Secretariat, United Nations Two United Nations Plaza, 12th Floor New York, New York 10017 Phone. 212 963 5958	1. Implementation of UNCED decisions related to forests at the national and international level including an examination of sectoral and cross-sectoral linkages. 2. International cooperation in financial assistance and technologytransfer. 3. Scientific research, forest assessment and development of criteria and indicators for sustainable forest management. 4. Trade and environment relating to forest products and services. 5. International organizations & multilateral institutions & instruments, including appropriate legal mechanisms.	Nitin Desai, Under-Secretary-General
Center for International Forestry Research (CIFOR)	P.O Box 6596 JKPWB Jakarta 10065, Indonesia Fax: 62251-622100, Phone: 62251-622622	Collaborative strategic and applied research in forest systems and forestry; promoting the transfer of appropriate new technologies and the adoption of new methods of social organization for national development.	Jeffrey Sayer, Director General

Root Causes

Continued from page 3

to make the kind of long-term investments in productivity improvements or resource protection that could help lift them out of poverty.

Somewhat surprisingly, many leaders in developing countries still do not see the quiet crisis in rural areas as a threat to the security of their governments or their nations. Occasionally, governments even use food as a tool in regional conflicts, trying to support some regions at the expense of others.

Such cynical, short-term policies must cease. Developing countries must make food security a priority if they want to increase internal stability and build a stronger base for future growth.

For that matter, developed countries and international institutions should strengthen their focus on improving food security and boosting rural economies. Over the past several decades, many developing countries have almost miraculously managed to raise food production fast enough to keep pace with population growth. Research leading to the development of high-yielding varieties played a major role in this success. This effort must continue and be promoted in countries that have not been successful in the past.

Continued growth in environmentally sound agriculture and food production is absolutely critical if developing countries are to reduce the risk of scarcity-induced conflicts. For one thing, more than half of the economically active population in developing countries works in agriculture. In sub-Saharan Africa and South Asia, the two regions where the food security situation is most worrisome, about two out of every three economically active people are engaged in agriculture. In these countries, economic progress must include gains in rural economic welfare.

Quite apart from the need to feed today's population is the effort to feed tomorrow's. As a group, the developing countries are expected to grow from the current total of about 4.7 billion people to about 6.5 billion people by the year 2020. That increase of 1.8 billion people is roughly three times the entire current population of sub-Saharan Africa. With so many more mouths to feed, any serious lapse in food production is potentially catastrophic.

The developed world is at a crossroads. If our commitment to help developing countries continues to weaken, we are likely to see instability and conflict become a chronic problem in some regions over the next few decades. If we can strengthen our commitment, we may see improving internal stability in many countries and gradual improvements in economic welfare. To take the latter course seems just and in the best interest of both the developed and developing worlds.

Dr. Per Pinstrup-Andersen is Director General of the International Food Policy Research Institute (IFPRI).

Can High-Inequality Developing Countries Escape Absolute Poverty?

A study by Martin Ravallion, World Bank

Do the poor face the same prospects for escaping poverty in high-inequality developing countries as in low-inequality countries? Is it possible for inequality to be so great as to stifle prospects of reducing absolute poverty, even when other initial conditions and policies are favorable to growth? Household survey data for developing countries suggest that initial distribution does affect how much the poor share in rising average incomes. Higher initial inequality tends to reduce growth's impact on absolute poverty. By the same token, higher inequality diminishes the adverse impact on the poor of general economic contraction.

Combining this evidence with that from recent investigations of inequality's effect on growth, Ravallion finds that, if inequality is high enough, countries that would have very good growth prospects at low levels of inequality may see little or no overall growth and little progress in reducing poverty—or even a worsening on both counts.

The data Ravallion uses suggest that such cases do occur. The precision with which key parameters have been estimated makes it difficult to say with confidence how common such cases are, but they appear to be in the minority. What appear to be the best available estimates suggest that about one-fifth of the spells between surveys he analyzed were cases in which poverty was rising, yet positive growth in the mean (and hence falling poverty) is predicted at zero inequality. Inequality can be high enough to result in rising poverty despite good underlying growth prospects.

The paper is part of a larger effort to understand why some economies do better than others in reducing poverty. Copies are available from psader@worldbank.org (World Bank abstract)

In the next issue...

- **The Systemwide Program on Property Rights and Collective Action**
- **Striga: A Formidable Enemy**

Biotechnology in Developing Countries

In recent years, biotechnology has been considered as an essential tool for socio-economic development by an increasing number of developing countries.

Yet, if anything, as the science frontier of the technology is advancing at an ever accelerating pace, commercial entry into modern biotechnology for most developing countries is rapidly moving away.

Globally, biotechnology science has been profoundly influenced by two factors, namely, the drastic reduction of public funds for research and the dominant role of the private sector in biotechnology R&D for health care, agrifood and other industrial applications.

The compound effect of these factors has been that technological advancement has remained stagnant in those areas that have been deemed unattractive in terms of returns on investment.

These are precisely those areas that are of prime importance for developing countries (e.g. orphan crop and infectious disease research) and in which biotechnology can have a profound effect.

Despite this, donor and technical support agencies have been reluctant to redirect part of their investments away from other conventional types of technology assistance towards biotechnology. The reason that is often invoked is the lack of an enabling environment in most developing countries which would translate biotechnology R&D or import products and services into community-level benefits.

However, it is becoming increasingly evident that conventional programs addressing health care and agricultural productivity needs in the developing world are becoming dependent on biotechnology to enhance their delivery prospects and benefit impacts. Clearly, in developing countries, biotechnology R&D is not the be all and end all. It needs to be coupled with actions to strengthen adoptive capacity (i.e., introduction of information and other key technologies) and to introduce policy and institutional reforms, conducive to public and private investment.

The reason for this is that the ability of developing countries to use biotechnology for public good depends primarily on their capacity to absorb and adapt proprietary technology to their specific needs. Policies with regard to intellectual property protection, increasing scope for intervention, and biosafety are essential in generating an enabling environment for the application of biotechnology.

International agencies have an increasing role to play in identifying areas where the interests of the private sector and the aspirations of developing countries are not mutually exclusive, and forge public-private partnerships in these areas.

This editorial is reprinted with kind permission of BINAS News (Vol.3, 1&2, 1997), the Biosafety Information Network and Advisory Service newsletter, jointly published by the United Nations Industrial Development Organization (UNIDO) and the International Centre for Genetic Engineering and Biotechnology (ICGEB).

Unsafe Application

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pesticide donations provided by foreign aid programs. In the absence of environmentally sound disposal facilities, stocks are constantly increasing. FAO is calling for a concerted global effort to dispose of this hazardous waste and to avoid further accumulations.

"Obsolete pesticide stocks are potential time bombs," said Niek van der Graaff, head of FAO's Plant Protection Service. "Leakage, seepage, and various accidents related to pesticides are quite common and widespread. Storage conditions rarely meet internationally accepted standards. Many pesticide containers deteriorate and leak their contents into the soil, contaminating groundwater and the environment. Most stores are in urban areas or close to public dwellings."

In Africa and the Near East, obsolete pesticides have become a source of great environmental concern, the report said. Some stocks are over 30 years old and are kept in poor conditions with few or no safety precautions. There is not a single country that is not affected by the serious environmental hazards associated with obsolete pesticides. Unless quick action is taken, the situation can be both catastrophic and irreversible, FAO said.

Over the years, an enormous variety of pesticides have been imported by developing countries as donations from aid agencies or governments. "Of the known total figure of $672 million-worth of pesticides imported into Africa in 1993-94, at least 40 percent, or $269 million-worth, might have been wasted," says an FAO report. Data from other regions show that the problem is not limited to Africa, but also exists in Eastern Europe, Asia, and Latin America.

Common reasons for pesticide leftovers, include:

- the banning of pesticides that are still in storage;
- prolonged storage of products with a short shelf life;
- difficulties in forecasting outbreaks of pests such as locusts;
- excessive donations (inappropriate, untimely and uncoordinated);
- late arrival of donations (out of season); and
- inadequate storage facilities; lack of staff trained in storage management.

(FAO)

Egyptian Farmers Achieve One of the World's Highest Rice Yields

Egyptian farmers, with the help of Egyptian researchers and the International Rice Research Institute (IRRI), are producing one of the world's highest rice yields. In 1995, the average Egyptian rice farm yield was 8.2 tons per hectare, up from just 5.43 tons in 1970—an amazing increase of 51 percent in 25 years. Three high-yielding IRRI lines were released in the country, one as IR28, the other two with local names, Sakha 1 and Giza 181.

Over the past 20 years, Egypt has also been an active participant in trials of the International Network for Genetic Evaluation of Rice (INGER), a network headquartered at IRRI. Several rice varieties tested through INGER have been released in Egypt, and 1,045 promising entries from the network were used as parents in breeding programs. Some 555 breeding lines were utilized for resistance to blast disease and the stemborer pest, and for tolerance to saline soils and low temperatures. At IRRI's main experimental station in Los Banos, Philippines, Egyptian rice breeding materials have been grown for the last 17 years, and crosses made from them.

IRRI's rice research collaboration with Egypt's scientific community began in the early 1970s. In 1980, IRRI collaborated with Egypt and the University of California in a six-year Rice Research and Training Project, financed by USAID.

As a result of the project, an integrated Rice Research and Training Center (RRTC) was established at Sakha in January 1987. This project involved research collaboration between IRRI and the National Agricultural Research Project of the Egyptian Ministry of Agriculture and Land Reclamation.

The project enhanced ongoing research programs to develop high-yielding disease-resistant varieties with desirable agronomic and grain characteristics for the Delta rice-growing areas. The project also introduced more water-efficient rice culture and improved the Egyptian rice seed industry to ensure quality seed for farmers. IRRI also assisted Egypt in developing a tissue culture laboratory, improving the seed storage system, developing computer databases for evaluating rice germplasm, and advancing knowledge of weed management. The collaborative research and training programs contributed to increasing Egyptian farmers' rice yields from 6 to 7.9 tons per hectare during the life of the project.

Salinity, too much salt, is the number one soil problem of the rice-growing areas of North Africa and West Asia, resulting in low yields from rice plants. Tolerance for salinity is rare in the types of rices grown in this region. Genes controlling salt tolerance have now been identified with the aid of biotechnology at IRRI. Transfer of salt-tolerant genes to rice cultivars in the region will help solve the soil salinity problem.

(IRRI)

Rice demonstration field, Egypt (Richard Gutman)

Watch the Color, Save Fertilizer...

An inexpensive leaf color chart to gauge the fertilizer need of rice plants has jointly been developed by CREMNET-IRRI, the Crop and Resource Management Network, and the Philippine Rice Research Institute (PhilRice). The chart has seven gradients of color from yellowish green to dark green. A simple instruction card in the local language will go with the chart and help the farmer to determine the level of nitrogen application needed in the rice field. PhilRice will be distributing 15,000 leaf color charts to extension agents and farmers in the Philippines this year. Training to educate farmers and extension workers has already started. CREMNET will soon extend this technology to other rice-growing countries of Asia. The color chart is one among several ways to improve nutrient management in irrigated areas grown with hybrid rice and high yielding varieties to obtain increased yields and attain better nutrient use efficiency. IRRI scientists aim at increasing the rice plant's uptake of available nitrogen and improve the efficiency of absorbed nitrogen. CREMNET is currently working with national research and development organizations to facilitate the free exchange, participatory evaluation, and promotion of promising components and concepts of information-intensive technology for more efficient crop and resource management in rice-based farming systems.

(IRRI)

(ILRI)

Cassava Green Mite Victory

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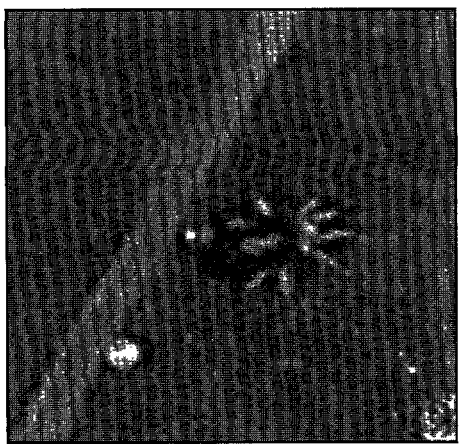
reduction in GCM populations is less dramatic.

After its introduction to the Africa's cassava belt in 1993, *T. aripo* found a conducive environment to prey on CGM. Impact assessment studies carried out by IITA at the sites where the CGM natural enemies had been released revealed that cassava yields increased by 35 percent within one season. Farmers are gaining about 70



Green spider mite (IITA)

US-dollars per hectare of cassava planted. In West Africa alone this adds up to a total profit per planting season of about $60 million for the cassava farmers.

According to Steve Yaninek, *T. aripo* was first released on cassava farms in 1993 in Benin after it had been transported from Brazil. It has subsequently been released in 11 countries and is now confirmed as established in all of them, except Zambia. *T. aripo* has also spread into Togo and Côte d'Ivoire from neighboring countries. It spreads about 12 km in the first year, and as much as 200 km in the second year. Today, the CGM predator has been established on more than 400,000 square kilometers of Africas cassava growing areas.

"*T. aripo* is able to spread quite easily," says Steve Yaninek, "because it has many food sources—for instance red mites, whiteflies, maize pollens, honey dew, and plant exudates—on which it can survive. However, in order to reproduce it requires mite prey." Tests have shown that in the absence of the CGM, *T. aripo* either disperses to find CGM or goes extinct locally, thus not becoming an ecological nuisance.

(IITA/CIAT).

NEWS

Pearl Millet Boom in Brazil

In Brazil, pearl millet has been rapidly adopted by farmers as the ideal cover crop for no-till soybean production. It is estimated that over 1 million hectares of pearl millet were sown last year in Brazil, and the area is expanding rapidly. In terms of area sown to the crop, Brazil is already one of the top ten pearl millet producing countries.

A team of four scientists from the Japanese International Cooperation Agency (JICA)/ Brazilian Agricultural Research Corporation (EMBRAPA) project "Sustainable agricultural development and natural resources conservation in the Brazilian cerrados" visited ICRISAT Asia Center to obtain information on pearl millet genetic resources, breeding, seed production, and agronomy.

The use of pearl millet as a cover crop-cum-mulch in no-till soybean production in the Brazilian acid soil savannas, or cerrados, exploits the crop's rapid vegetative growth rate, adaptation to soils of low inherent fertility, and ability to draw on nutrients and water lying deep below the soil surface. The mulch helps control weeds, concentrates soil nutrients in the surface layers, conserves soil moisture, and protects the soil surface from erosion and compaction.

These factors combine to increase productivity and economics of no-till soybeans, reducing energy inputs and improving sustainability of production of this important cash crop in the cerrados. This, in turn, will reduce pressure to bring more fragile environments into cultivation, including the humid forests of the Amazon basin.

Pearl Millet in India

The first officially recognized release in India of a pearl millet topcross hybrid was announced last year by government authorities in the State of Madhya Pradesh. The hybrid, named 'Jawahar Bajra Hybrid 1 (JBH 1)', was developed after three years of testing by ICRISAT scientists and the Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV) College of Agriculture in Gwalior, Madhya Pradesh. This topcross hybrid has high grain yield potential moderate height, medium-long nonbristled compact panicles, and medium-bold, globular grain. Both the hybrid and its topcross pollinator are highly resistant to pearl millet downy mildew.

Gujarat State Fertilizers Company Limited (GSFC), a joint sector venture and India's largest integrated fertilizers and petrochemical complex has developed and released in Jul a pearl millet hybrid 'Sardar Hybrid Bajra 1 (SHB 1)' based on lines derived from material supplied by ICRISAT. SHB 1 yields about 20 percent more grain of better quality and matures earlier than existing hybrids. It is resistant to downy mildew.

(ICRISAT)

Livestock

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feed to their sheep. The weeds slightly reduce cereal grain yields, but the productivity of the system as a whole is higher than if they sprayed herbicides to control the weeds. And the environment is protected.

The research task facing the International Livestock Research Institute (ILRI) and its research partners is to develop ways of managing livestock that maximize the benefits to smallholders while minimizing any harm livestock can inflict on the environment. Well-managed, the benefits to smallholders of keeping livestock are overwhelming.

(ILRI)

Dryland Farmers

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ICARDA, based in Aleppo, Syria; and ICRISAT, based in Andhra Pradesh, India.

Both centers are active in all developing regions, with a special focus on Asia, the Middle East, and Africa. A priority of their work is to improve the main staples of the dry regions—hardy food and feed crops that provide a minimum of food security under harsh climatic conditions and with little water, such as the major dryland cereals millet, sorghum, and barley; groundnuts; and legumes such as lentils, chickpeas, pigeonpeas, and faba beans.

Major Crops

Although largely unknown and little traded in world markets, these crops constitute the main product of 800 million farmers in dry regions, and the population's basic food.

- **Barley**—Barley is suitable for marginal lands with low rainfall and helps to support livestock production in the Middle East. In Latin America it is mainly used for direct human consumption. In one of its driest sites in Syria, ICARDA succeeded in breeding a barley variety which almost doubled grain yield to over 1 ton per hectare (over 0.4 ton per acre) and also increased straw yield. ICARDA is now breeding barley together with farmers who plant the new lines simultaneously with ICARDA in its test fields. The best cultivars are then jointly selected according to the farmers' criteria; they may, for instance, prefer better straw quality to more grain yield.
- **Sorghum**—Sorghum originated in Africa. Half of India's hybrid sorghum acreage is planted to ICRISAT-derived varieties. Early maturing ICRISAT-derived varieties which avoid late season drought are helping to stabilize production in many countries of sub-Saharan Africa. ICRISAT is also working to make sorghum more nutritious for humans by increasing the grain's protein content, while also improving the crop's yields and drought tolerance.
- **Pearl Millet**—A hardy plant important in south Asia and Africa, pearl millet needs very little water. Nearly half of India's pearl millet acreage is derived from varieties improved by ICRISAT in collaboration with the national research program which combine higher yields with resistance to downy mildew, better drought tolerance, and higher protein levels.
- **Groundnut**—Groundnuts are important for direct consumption and as oil crops, especially in Asia and Africa. Early maturing and disease resistant ICRISAT-derived varieties promise a breakthrough in southern African groundnut production. Overall, CGIAR scientists are working to improve disease resistance, oil extraction quality, and taste.

Hardy food and feed crops that provide a minimum of food security under harsh climate conditions...

- **Lentil**—ICARDA has developed drought-tolerant varieties of this important pulse crop which has its origin in western Asia. The new strains have been widely adopted by farmers in Jordan, Libya, and Syria because they give economic returns even in dry years. Genetic material from the Middle East and Argentina has been used by ICARDA and ICRISAT to improve southern Asian lines, and a number of new varieties have been released to farmers in Bangladesh, India, Nepal, and Pakistan.
- **Faba Bean**—Often called the poor man's meat, faba bean is important in China, the Middle East, Ethiopia, Eritrea, and parts of South America. The new high-yielding varieties and better production practices have helped Egypt achieve self-sufficiency and strongly increased output in Sudan, Ethiopia, and other countries.
- **Chickpeas**—An important, protein-rich legume that originated in western Asia and is directly consumed. ICARDA and ICRISAT have, jointly with national programs, developed cold tolerant and disease resistant chickpea cultivars which can be planted in winter—instead of spring—to take advantage of seasonal rains. Yields have increased by 60 percent. Chickpea research is enabling increased use of the crop in rotation with rice because of the chickpea's ability to fix nitrogen in the soil and its nutritional and income generating aspects.

Research Strategies

In their work to improve crops and farming systems in the dry and semi-arid regions, CGIAR scientists seek to dramatically shorten the growing season for all crops. While the Green Revolution in the 1960s and 1970s succeeded in shortening the growing season for irrigated crops, thus allowing farmers to harvest two or more crops a year, progress has been much slower in the dry regions.

Without supplementary irrigation, most dryland areas can produce only one harvest a year, during the rainy season. CGIAR scientists are combining a variety of measures to allow farmers to reap more than one harvest a year. Quicker growing plants mature before summer heat and drought can affect them; water harvesting techniques allow concentration of available water where it is most needed. Better water management methods developed by ICRISAT in Ethiopia, for instance, have helped farmers optimize the use of their most precious resource.

Biological control of pests permits farmers to save on pesticides and protects the farmer's health and the environment. ICRISAT, for instance, introduced among farmers the use of a small insect, the mud wasp, to control the pod borer, the world's most devastating chickpea pest. Integrated pest management (IPM) integrates biological control, breeding for resistance, cultural control, and judicious use of pesticides in a robust and viable system that sharply cuts use of chemicals.

Both CGIAR centers collaborate closely with the national research programs in their mandate countries, as well as with non-governmental organizations, advanced research labs in North and South, the private sector, and farmers' associations. In setting their priorities, the centers actively seek the guidance of their partners, especially women, who constitute half of all farmers in the dry and semi-arid regions. In southern and eastern Africa women predominate as farmers. Improving the crops they grow for their families and rendering their work less hard

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Dryland Farmers

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and time-consuming is one of the most effective ways of reducing poverty—and drudgery.

Livestock and Mixed Farming—In addition to their efforts to improve crop production, the CGIAR centers also seek ways to improve dryland livestock production and the combined crop-livestock systems. Vast tracts of arid and semi-arid land are unsuitable for crop production but support livestock, especially small ruminants such as sheep and goats. Livestock not only constitute a vital supply of protein, but are an important sector of the economy by providing the livelihood of some 300 million pastoralists worldwide from land that would otherwise be unproductive.

Marginal Land Rehabilitation Using Sheep—ICARDA has succeeded in using sheep to transfer legume seed from improved pasture fields to neighboring marginal or degraded land. The sheep are left all day grazing on the improved pasture. For the night, they are moved to a degraded field. It was found that the legume seed passed the digestive tract of the sheep undigested and then germinated, thus improving the marginal land.

Water Harvesting—ICARDA has developed simple but effective water harvesting techniques which are rapidly being adopted in Jordan, one of the world's water-poorest countries. At a project in Syria, ICARDA is developing methods to use classified satellite data and data on topography, drainage systems, soil types, vegetation, and climate for planning water harvesting on a large scale. The methodology is expected to be suitable for all similar areas of the world

Germplasm Conservation—Both ICRISAT and ICARDA, like other CGIAR centers, devote a major effort to gathering wild relatives and landrace varieties of the dry areas' important food and pasture crops ICARDA's genebank, for instance, holds about 111,000 germplasm samples collected from more than 40 countries. This precious collection accounts for more than one-fifth of all accessions held by CGIAR centers, which together constitute the world's largest collection of agricultural biodiversity The genetic material serves as the key source of genes resistant to pests and diseases, and tolerant to extremes of temperature, drought, and toxicities in the soil

ICARDA is located in the heart of an area which is a birthplace of agriculture, and of some of the world's greatest civilizations. The ICARDA region contains three of the world's eight centers of crop origin. Archaeological findings have shown that—some 10,000 years ago—barley, wheat, lentil, pea, flax, and vetch were all domesticated in the ICARDA region. Landraces and wild relatives of these crops, containing precious genes for breeders to develop new varieties, are found in the region to this day. From material jointly developed by ICARDA and national programs, over 230 varieties of barley, lentil, faba bean, bread wheat, durum wheat, kabuli chickpea, pea, and forage legumes have been released in both developing and industrial countries, and the center has trained over 7,500 young researchers, many of whom now occupy key positions of responsibility in their national programs.

ICRISAT serves the needs of the semi-arid tropics where one-sixth of the world's population lives, half of them (380 million) in absolute poverty. ICRISAT's mandate areas are marginal lands, such as the fringes of the Sahara where starvation and malnutrition are recurrent. The center's work has resulted in the release of 365 new crop varieties which improved the quantity and dependability of the food supply of the rural poor, and the entire population. Of these varieties, 20 provide an estimated annual benefit of US$230 million to poor farmers, over seven times ICRISAT's budget. These achievements are the result of ICRISAT's close collaboration with national programs and other research partners.

Desertification

by Elizabeth Dowdeswell
Executive Director, United Nations Environment Programme

It would be a mistake to view the various ecological trends such as desertification as isolated, localized threats. Local threats they certainly are. But, they also form a mosaic whose patterns help define many of the key global concerns of our age—issues which, directly or indirectly, touch upon the lives of everyone.

Desertification is a complex phenomenon whose effects are manifested socially. The hardships suffered by the millions who stay behind in a land gradually losing all its productivity and the millions of those who decide to leave their impoverished surroundings to an even more miserable existence in an urban setting—are the social manifestations of this malaise.

These marginalized citizens—often women—have little support and few to care for them. Economically invisible, they do not appear on the spread-sheets of economists; they may have very little access to community services, to national programs, even to the processes of democracy. They may have no security of tenure on their land or even for the trees they plant.

Programs in the past to control desertification have had limited success. Those which succeeded did so only in some areas and only for limited periods. Even small projects which were successful have seldom been replicable over large areas. The reasons for our failure are apparent: a palpable lack of political will, inadequate resources, emphasis on abstract planning rather than on field action, and neglect of the social dimensions of the problem.

Today, we have the knowledge and technical skills to halt these destructive trends. But it is political and economic factors, not scientific research, that will determine whether or not the wisdom accumulating in our libraries will be put into practice.

Governments must create the conditions of security of tenure and food security, within which these resilient but marginalized people can maintain sustainable livelihoods for themselves. If they do not, more people will suffer and require direct support, millions will migrate and the pressures and social tensions on the humid lands and the urban areas around the world will increase. Endless humanitarian relief after each succeeding crisis that has inevitably occurred is not the answer. It is in the interest of all of us that Governments act now to help the disadvantaged help themselves.

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CGIAR Chairman
Ismail Serageldin

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