Future Harvest Centers of the CGIAR
The success that the Green Revolution enjoyed in Asia in the second half of the 20th century has yet to be replicated in sub-Saharan Africa in the 21st century because of the latter continent’s diversity of farming systems, variable climate and small local markets. The challenge for agricultural research is to provide African farmers with the right technologies using approaches that work in conditions less favorable than those of the Green Revolution in Asia.

A search for suitable approaches, combined with partnership-owned research for development led by national programs in Africa and the Africa Rice Center (WARDA), has made a difference in the production of rice, a strategic crop for African economies. The initial impact came through developing and disseminating the NERICA family of new rice varieties for Africa, which unleashed the potential of the upland, rainfed ecosystems. The potential of the lowlands is much greater than that of the uplands, as the lowlands’ suitability to cropping intensification makes it possible to grow two or three crops per year, making rice more valuable economically. But agriculture in African lowlands is complex because of lack of water control, iron toxicity, weeds, diseases and pests. Yields from traditional rice varieties in this ecosystem are usually less than 1.5 tons per hectare, only 40 percent of the world average.

To develop suitable rice varieties, a breeding program was initiated using WARDA’s germplasm collection and led by a team of scientists from the national programs of West Africa and WARDA. Initial national partners were Burkina Faso, Mali and Togo. ROCARIZ facilitated shuttle-breeding in these countries to accelerate the evaluation of 740 intra- and interspecific breeding lines and ensure that widely adaptable lowland NERICA varieties were selected.

The most promising lowland interspecifics show low susceptibility to pests and diseases, which is vital for their success in the hard-pressed lowland ecosystem. The lines’ disease susceptibility scores were mostly lower than 5, on a scale of 1-9, for leaf blast and yellow mottle virus. The new NERICA varieties suffered less than 2 percent damage from insects.

To reduce the time between on-station trials and varietal release, WARDA scientists conducted farmer-participatory varietal selection in collaboration with the national programs, through which farmers selected about 60 lowland NERICA varieties.

The national partners, who were closely involved in this process, immediately saw the value of these new crosses, which have a yield potential of 6 to 7 tons per hectare and good resistance to major lowland stresses. This led to the official release in 2005 of two lowland NERICA varieties in Mali and four varieties in Burkina Faso. Given the high potential of the African lowlands, these new varieties are expected to have an even greater impact on African food security than the original upland NERICA varieties.

Partnerships speed the breeding, selection and dissemination of a new generation of lowland rice varieties bred for African conditions

The NERICA family of new rice varieties for Africa now includes lowland cultivars.

Africa Rice Center Cultivates Cooperation

The NERICA family of new rice varieties for Africa now includes lowland cultivars.

Africa Rice Center (WARDA)
Headquarters: Cotonou, Benin
www.warda.org
Over 2.4 million rural households in eastern and southern Africa, or at least 13 million people, have received seed of new common bean varieties in the last 18 months. In the 12 countries involved — Democratic Republic of Congo, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Rwanda, Swaziland, Tanzania, Uganda and Zambia — farmers (mostly women) are now evaluating 108 new varieties and nine other bean technologies, mostly to manage pests and diseases.

This achievement of the Pan-African Bean Research Alliance required African breeding lines with relevant traits, strengthened regional bean research networks, cost-effective seed production, and links for research and development combining national agricultural research systems (NARS), international agricultural research centers, NGOs and the private sector.

The NARS responsible for promoting new varieties became conscious of the need to understand the demands of farmers and consumers. This is especially true for a crop such as the common bean (Phaseolus vulgaris). Although markets grew rapidly along with Africa’s urban population in the 1990s, their development was hindered by fragmentation in preferences regarding color, size and culinary qualities, and by a range of production constraints. The Eastern and Central Africa Bean Research Network, managed by the Association for Strengthening Agricultural Research in Eastern and Central Africa, and the Southern Africa Development Community Bean Research Network — both managed by the International Center for Tropical Agriculture (CIAT by its Spanish acronym) — convinced their memberships to adopt market-oriented strategies.

National scientists learned to use participatory selection methods, following success with this approach in Rwanda by the Institute des Sciences Agronomiques du Rwanda and CIAT. They also became more aggressive in developing a portfolio of varieties adapted to a range of growing conditions. Initially, varieties developed at CIAT headquarters near the common bean’s Latin American center of diversity brought rapid gains. Then national breeding programs, regional breeding hubs (notably at the University of Nairobi), and network exchange mechanisms spurred further progress.

Consumer-oriented varietal development and vibrant networks to disseminate seed bring a fragmented, underperforming bean market to life.

While the common bean is not yet attractive to commercial seed companies, CIAT research shows that small farmers will happily pay to obtain starter packets of interesting new bean varieties and that these farmers can disseminate them further through low-cost, decentralized local seed systems. A recent impact study across several African countries showed that, where farmers have access to seed, the adoption of new bean varieties is often above 70 percent.

This approach started to work well on a large scale only when NARS bean researchers started systematically building local partnerships — signing at least 80 cooperation agreements in 2004 alone. NARS reported 343 local partner organizations in bean seed dissemination in 2005, including NGOs, government extension agencies, farmer organizations, local seed companies and unconventional actors in seed dissemination such as women’s groups, people living with HIV/AIDS and tobacco companies. Many NGOs copublished local translations of CIAT training manuals on small-scale seed production and sales, which are now available in eight languages. Training courses, often organized across crops with sister Centers, reached the staff of 105 partner organizations.
The Center for International Forestry Research (CIFOR) conducted and disseminated research that contributed to an Indonesian government decision to rescind an export ban that harms rattan farmers and producers. The ban was lifted following a 2005 invitation from the Ministry of Trade to a range of stakeholders, including CIFOR, to participate in a review of Indonesian rattan export policy.

During the review, CIFOR and its research partners drew on long-term research and an established network of collaborators to demonstrate the importance of rattan to the livelihoods of rattan producers in the province of East Kalimantan. Although rattan has been a steady livelihood for Indonesian farmers for hundreds of years, extreme fluctuations in the rattan sector over recent decades have often badly affected farmers’ income. According to CIFOR researcher Ramadhani Achdiawan, these negative impacts reflect changes in the market and policy environment surrounding rattan.

“Indonesia’s rattan industry has ridden a roller-coaster over the past 25 years,” Mr. Achdiawan reports. “The export ban has been imposed and lifted several times, causing drastic price oscillations and uncertainty and hardship among small-scale rattan farmers."

Most recently, in 2004, the rattan furniture industry lobbied the Ministry of Trade to restrict unprocessed and semiprocessed rattan exports,” he continues. “Twelve months later, after listening to agricultural researchers and not industry lobbyists, the ministry lifted the restriction.”

The 2004 ban reflected concerns about the Indonesian furniture industry’s international competitiveness. Banning unprocessed and semiprocessed rattan exports reduced supplies of raw materials to overseas competitors of the local furniture industry, especially to much more efficient, mechanized producers in China.

These arguments had been the mainstay of past rhetoric supporting the export ban through the 1980s up until the Asian economic crisis in 1998, when International Monetary Fund influence saw the ban withdrawn. The rhetoric had its seductive way again 6 years later, when the ban was retrieved from Ministry of Trade archives, dusted off and put back into force.

By this time, however, a considerable body of reliable information was at hand. CIFOR could draw on more than 8 years of research and provide NGOs, government agencies and industry representatives with the data needed to better judge the pros and cons of a rattan export freeze.

“Because we had such strong research, and perhaps because CIFOR is seen as apolitical, people trusted our data showing that the ban reduced rattan demand and hurt the incomes of rattan producers and harvesters,” explains Brian Belcher, Mr. Achdiawan’s research collaborator. “Our facts and figures also proved that the restriction did not make Indonesia’s rattan furniture industry more competitive, which was the main argument for the ban.”

The moral to this story is that good research and solid facts are essential to making good policy.

“Policymakers need impartial and sound data when making decisions that affect people and their environment,” concludes Mr. Achdiawan. “With its rattan research, I think CIFOR fulfilled that need.”
CIMMYT Offers Maize with No Striga Attached

The parasitic weed Striga infests 40 percent of Africa’s arable savannahs, threatening the livelihood of more than 100 million people who depend on cereal crops for food and income. Also called witchweed, Striga fastens directly to the roots of maize seedlings and sucks out nutrients, slashing yields by 50 to 100 percent. Maize farmers in Kenya, where Striga has invaded 400,000 hectares of farmland, lose at least US$50 million annually to the weed.

Taking advantage of a natural variation in maize, the International Maize and Wheat Improvement Center (CIMMYT by its Spanish acronym) and its partners have conventionally bred tropical maize varieties that withstand imidazolinone, the active ingredient in several herbicides. “The resistant maize seed is coated with a low dose of the herbicide, which kills Striga as it germinates, allowing the maize to grow clear of the weed,” explains CIMMYT agronomist Fred Kanampiu, adding that several years of the practice helps clear fields of residual Striga seed.

Four new maize hybrids have been released for marketing in Kenya under the name Ua Kayongo H1-4, which means “kill Striga.” Farmers are enthusiastic, as their comments in the Nairobi Daily Nation show.

“I have already seen major changes in my farm compared to my neighbors’, whose parcels remain covered with the purple flowers of the parasitic weed,” says one, Zedekiah Onyango of Nyahera, Kisumu District. “My maize yield is many times higher since I started using this maize, and I look forward to even higher yields.” Another small-scale farmer, Beatrice Ayoo, argued that the technology would be a cost-effective investment for the government, according to the Daily Nation.

An innovative technology to control the parasitic weed Striga takes root in maize-growing areas of the African savannah

CIMMYT sourced the resistant gene from the German chemical company BASF, bred imidazolinone-resistant maize varieties adapted to East African conditions, and developed, with the Weizmann Institute of Science, a seed-coating practice appropriate for poor farmers. Other partners in the project are the Kenya Agricultural Research Institute, Israel, the Rockefeller Foundation and private seed companies.

Farmers evaluating the technology plant the new maize the normal way, including intercropping with legumes and root crops. “I’ve been pulling and burying Striga on my 5-acre (2-hectare) farm for the past 17 years, and the problem has only grown worse,” says Rose Katete, a farmer in Teso District. “Ua Kayongo has provided the best crop of maize that I’ve ever grown.”

“Under Striga-infested conditions, the new maize hybrids out-yield the checks by more than 50 percent and provide near-total Striga control,” confirms CIMMYT Maize Program Director Marianne Bänziger, citing several years of field trials.

Three Kenyan seed companies have initiated seed production for imidazolinone-resistant maize. A consortium of farmer-educating non-governmental organizations and extension services led by the African Agricultural Technology Foundation are conducting on-farm demonstrations in western Kenya. Over the next five years, farmers in Tanzania, Uganda and Malawi will receive the new Striga control package.

Blue flowers betray the parasitic weed Striga as it attacks maize in Kenya.
An integrated approach to managing the Andean weevil has dramatically reduced losses in several crops important to villagers in the high Andes. In this environment, weevils are the most dangerous pest of the starchy Andean tuber oca (Oxalis tuberosa), able to severely damage nearly all tubers. Other weevils, just as damaging, are present in the Andean potato (Solanum spp.), mashua (Tropaeolum tuberosum), and ulluco (Ullucus tuberosus). Potato is a staple food, and mashua, oca and ulluco are important complements.

Over the last four years, International Potato Center (CIP) researchers, with support from the McKnight Foundation, have worked with local groups and staff of Peru’s Universidad Nacional de San Antonio Abad del Cusco and the University of California Davis in the United States, to develop and apply a system of integrated management to Andean weevils. The approach combines ancient indigenous knowledge and modern scientific research. The first problem was to identify, from among the many types of weevil found in fields, the actual species that do the damage. In one village, 32 children were trained to recognize weevils and went out to collect 57,000 adult weevils over a two-week period for taxonomic identification. They were rewarded with notebooks, pens, pencils and erasers to use in school. Project workers subsequently identified for the first time the main weevil species attacking oca. Those that attack ulluco and mashua appear to be different but have yet to be positively identified.

“Strategies are oriented to reduce the infestation from the over-wintering weevil population,” explains CIP researcher Jesus Alcazar, adding that, in 2003, a species of nematode was isolated from potato weevil larvae in soil taken from an Andean potato storage shed. “Lethal dose experiments showed that it is highly virulent to the oca weevil larvae, pupae and over-wintering adults inside oca tubers.” Researchers introduced this nematode into the weevil population and popularized a range of simple, low-cost techniques for pest control. These include planting weevil-free sprouts, putting ash at the base of the plants, using chickens as predators, early harvesting, using sheets at harvest to keep larvae from pupating, destroying crop residues, and winter plowing after the harvest. Together, these methods have more than halved — and in some cases almost eliminated — the weevils and their damage to oca, Andean potatoes, and ulluco. They have also reduced the need for insecticides, benefiting the health of farmers, their families and consumers.

“The impact of the work is spreading as farmers adopt the techniques in more than 30 communities around the experimental site,” observes CIP Andean crop specialist Carlos Arbizu.

Research results have attracted great interest when disseminated through schools, farmers’ schools and workshops, seminars, and local radio. Hundreds of farmers, agronomists, technicians, and school and university teachers in Peru’s Cusco and Apurimac departments are becoming involved.

“These outputs will strengthen the on-farm conservation of Andean tubers,” concluded Willy Roca, head of the Genetic Resources Conservation and Characterization Division at CIP.

Integrated pest management improves weevil control and helps keep traditional tuber crops down on the farm in the high Andes

International Potato Center (CIP)
Headquarters: Lima, Peru
www.cipotato.org
Desertification and global warming lend urgency to conserving dryland agrobiodiversity, which sustains livelihoods in many local communities and provides useful genes for plant breeding worldwide. The International Center for Agricultural Research in the Dry Areas (ICARDA), working with national partners, has collected more than 131,000 accessions of crop landraces and their wild relatives from all over the world for storage in the Center’s gene bank. Conservation on site in farmers’ fields or protected areas is a complementary method that conserves a larger portion of the gene pool and benefits from natural selection and local knowledge. Success depends on suitable policy reforms in national programs.

With funding from the Global Environment Facility provided through the United Nations Development Programme, ICARDA has collaborated for 6 years with the International Plant Genetic Resources Institute and the Arab Center for the Studies of Arid Zones and Dry Lands to operate the Conservation and Sustainable Use of Dry-Land Agrobiodiversity project in Jordan, Lebanon, Palestine and Syria. The project develops technological, socioeconomic, institutional and policy options to promote in situ conservation of landraces (or traditional cultivars) and wild relatives of cereals, legumes and fruit trees that originated in the region. Policy guidance to governments has fostered the institution of agrobiodiversity programs and units in national research bodies, ministries of agriculture and forestry departments.

Syria has introduced a new biodiversity curriculum in the 9th and 10th grades. Palestine is in the process of implementing it, and Jordan and Lebanon will follow in 2006 or 2007. School children entered more than 1,000 paintings in a contest to demonstrate their understanding of agrobiodiversity conservation, and four students from each country were selected for awards.

Government forestry nurseries in Syria, Palestine and Jordan are propagating diverse wild relatives of fruit trees, and more than 500,000 seedlings of target landrace species have been planted in Syria. In Lebanon, NGOs are propagating and distributing the seedlings. In Jordan, the Forestry Directorate of the Ministry of Agriculture has created a unit to establish nurseries.

Heightened awareness of agrobiodiversity conservation has facilitated collaboration with tourism and education ministries, other projects, and NGOs. Working with communities, governments have identified sites rich in agrobiodiversity, and many target species have been collected and placed in gene banks. Protocols for managing databases derived from ecogeographic botanic surveys have been set, and a policy framework has been developed and shared.

The project has provided training and technical support for more than 1,500 people, including 850 women, on various value-adding technologies and alternative income sources such as dairying, honey and mushroom production, food processing, and ecotourism. Mass media, documentary films, posters, biodiversity fairs and rural theater have increased public awareness. Further success will depend on full recognition of the role of local communities, inviting their participation and ensuring their empowerment and benefit sharing. The project has highlighted activities that will improve local livelihoods while conserving agrobiodiversity, but more national and international support is needed.

Efforts to conserve dryland agrobiodiversity in West Asia benefit from successful policy reforms and awareness-building activities.
Collaborative research between the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Haryana Agricultural University in India has created a new pearl millet hybrid, HHB 67-2, that resists downy mildew caused by the fungus Sclerospora graminicola. HHB 67-2 is the first-ever product of marker-assisted breeding in pearl millet to be released for cultivation in India.

The Haryana State Varietal Release Committee approved the release of HHB 67-2 in January 2005, providing ample time for seed to reach farmers before the rainy season. The new hybrid is an improved version of the popular pearl millet hybrid HHB 67. The original HHB 67, released in 1990 by Haryana Agricultural University, is grown on at least 400,000 hectares in the northern Indian states of Haryana and Rajasthan. The cultivar is popular because it matures in 65 days, thereby escaping end-of-season drought and providing an opportunity for double cropping.

In recent years, however, the highly preferred HHB 67 began to succumb to downy mildew. Attempts to improve the parental lines of HHB 67 for downy mildew resistance were successful, and after being tested for 3 years, the best of the resulting hybrids was identified for release.

By rapidly adopting the improved hybrid HHB 67-2, farmers in Haryana and Rajasthan can avoid grain losses of about 288 million rupees (US$6.4 million) in the first year of a major downy mildew outbreak, in which up to 30 percent of the pearl millet harvest can be lost (estimated from an average grain yield of 800 kilograms per hectare and a minimum selling price of 3 rupees per kilogram).

To develop the new hybrid, the parental lines of the original hybrid were improved for downy mildew resistance through marker-assisted and conventional backcross breeding programs at the ICRISAT campus at Patancheru, India. The gene for downy mildew resistance was added to the male parent, H 77/833-2, through marker-assisted breeding using ICRISAT elite parent ICMP 451 as the resistance gene donor. The gene for downy mildew resistance was added to the female parent, 843A/B, from ICRISAT line ICML 22 through conventional backcross breeding. The All India Coordinated Pearl Millet Improvement Project field-tested the new hybrid at various locations over 3 rainy seasons.

Modern, molecular marker-assisted selection allowed breeders to develop the male parent for HHB 67-2 in one-third of the time required for developing the female parent by conventional selection. Marking the gene responsible for downy mildew resistance in ICMP 451 meant that its transfer to the next generation — progeny of ICMP 451 and the male parent of HHB 67 — could be checked at the seedling stage, saving precious breeding time. In conventional breeding, the presence of a gene can be verified only after the plant grows to maturity and seed from it is sown to screen for downy mildew resistance.

ICRISAT has now produced breeder seed of the parental lines of HHB 67-2.
Across much of the developing world, women are on the front line in the fight against hunger, poverty and environmental degradation. Donors, policymakers and development practitioners have increasingly come to understand that, to be effective, their programs must empower women. With its long track record of gender research, the International Food Policy Research Institute (IFPRI) has contributed significantly to this understanding.

Gender considerations can strongly affect the control and allocation of family resources. Understanding them is critical to designing and implementing effective programs and policies.

IFPRI recently completed a 10-year research initiative to examine the dynamics of resource allocation within households and suggest ways to ensure that programs achieve their development goals. This research has been disseminated through 59 journal articles, nine book chapters, four books, four research reports, 45 discussion papers, 125 presentations and six media events.

The implications of this research are clear. It is not enough to target resources to poor families. When programs directly target women and girls, development outcomes improve. These studies have had considerable impact in Bangladesh and Guatemala, and have influenced the design of several conditional cash-transfer programs in Latin America.

The impact of IFPRI’s overall program of gender research has been broader, changing minds about the importance of gender issues. For example, IFPRI studies have:

- documented the importance of improving property rights for women,
- quantified the benefits of increasing women’s human and physical capital,
- established the critical link between women’s status and child nutrition, and
- demonstrated the productivity impact of targeting agricultural technology and inputs on women.


The challenge now is to bridge the gap between research and action. While practitioners often know about general development or technical issues, many lack the understanding and resources necessary to effectively integrate gender issues into projects and public policy initiatives.

Publications highlight a decade of gender research and help development programs apply research results toward achieving their goals.

When programs directly target women and girls, development outcomes improve.

More than a decade of IFPRI research has demonstrated that empowering women is essential for winning the fight against poverty and hunger. Equally important, this work has provided policymakers, donors, and NGOs with tools to create more effective programs on the ground. Through its recently established Gender Task Force, IFPRI continues to focus attention on gender issues and share findings with researchers, donors and policymakers.
Food production on the savannah of West Africa is not keeping pace with population growth. Agriculture continues to be based on traditional intercropping systems with few inputs. The International Institute of Tropical Agriculture (IITA), in collaboration with national, regional and international partners, has developed an intercropping system that holds great promise for increasing food and fodder production without harming the environment or degrading the soil. Improved strip cropping using durable, high-yielding varieties of cowpea and cereals has shown gains in productivity and gross income compared with traditional intercropping systems, in which a single row of cereal alternates with a single row of legume. In the improved strip-cropping system, two rows of maize, millet or sorghum are planted between four rows of improved cowpea varieties. Minimal inputs of fertilizer and pesticide are applied as needed.

The system enjoys the benefits of traditional cropping knowledge and methods but is not limited by them. New, dual-purpose (food and fodder) cultivars of cowpea, maize, sorghum and millet produce enhanced quantities of biomass. This means more crop residues to feed to small ruminants penned in permanent enclosures at the homestead, from which manure is easily gathered for spreading on croplands to enhance system productivity and sustainability. Cowpea is an important source of nutritious food and fodder in the semi-arid tropics, especially in West Africa. Traditional varieties spread laterally as they grow and take over 130 days to mature, offering a yield potential of less than 1 ton per hectare. Systematic breeding has produced cowpea varieties that offer improved grain quality and more fodder from plants that stand erect or semierect and mature in only 60 to 75 days. Some yield up to 2.5 tons of grain and fodder per hectare, with protein representing 25–29 percent of grain weight and 15–18 percent of residual hay weight. The improved varieties fit well in the niches of existing cereal-based cropping systems, maintain soil fertility and reduce the seed bank of the parasitic weed Striga, thereby enhancing cereal productivity. New intensive strip-cropping systems of maize-double cowpea, sorghum-cowpea, and millet-cowpea have increased total biological productivity and gross income by 100–300 percent over that of traditional intercropping systems.

West African farmers grow more food and fodder with a new interplanting system that uses improved cowpea and grain varieties

Hajia Rabo Abdulrahman, president of Albarka Women Farmers Association in Yakasai Ward of Nigeria’s Kano State, reports that adopting improved cowpea strip cropping financed most of her domestic needs in the last year and allowed her to buy her first piece of farmland. “I never dreamed of ever having a field of my own,” she says. “Now that I have one, I’ll increase my production.”

In 2005, 1,500 Nigerian producers tested IITA-improved pest-resistant cowpea varieties using the new cowpea-cereals strip-cropping system. The new system itself was tested by more than 3,000 farmers and, from 2002 to 2005, spread to more than 250,000 farmers. This demonstrates that combining the new extra-early maturing Striga-resistant and drought-tolerant cowpea varieties with improved strip cropping has great potential to sustainably increase food production by smallholder farmers throughout West Africa.
The protozoan parasites that cause African animal trypanosomosis, known as sleeping sickness in humans, are transmitted by the bite of infected tsetse flies. Trypanosomosis is a major constraint to African development across a swath of the continent as large as the continental United States or the whole of Australia. The International Livestock Research Institute (ILRI) has been working in the Ghibe Valley of southwestern Ethiopia for more than two decades to develop, test and demonstrate effective methods of controlling tsetse fly populations, as well as to develop community-based mechanisms for sustainably delivering animal-health services to control this and other livestock diseases.

ILRI’s research has demonstrated that using so-called “pour-ons” — regularly administering a protective treatment by pouring pesticide along the backs of cattle — offers an effective way to control trypanosomosis and protect farmer incomes. This research-cum-control project was so successful that communities in the Ghibe Valley have recently begun to organize their own animal-health service cooperatives to ensure the sustainable delivery of this and related animal-health services.

In recent years, representatives of the Ethiopian Ministry of Agriculture and Rural Development, Ethiopian Science and Technology Agency (ESTA), and regional bureaus of agriculture and rural development (BoARDS) have made several visits to the Ghibe Valley to learn from ILRI’s experience in controlling the disease.

ESTA, in collaboration with the BoARD of the southern region of Ethiopia, has adopted the pour-on technology as an important component in its strategy to suppress tsetse populations in its Southern Trypanosomosis Eradication Project. Agriculture bureaus in two other Ethiopian regions — as well as NGOs in Ethiopia, including Farm Africa, SOS Sahel and ActionAid Ethiopia — have taken up and applied research outputs from ILRI’s long-term research project on controlling tsetse flies and trypanosomiasis in the Ghibe Valley.

The main ILRI research output being taken up is how to use pour-ons in a village setting as an effective way to control trypanosomosis. The Bureau of Cooperative Promotion of the Southern Region has approved two farmer cooperatives for animal-health services in the Ghibe as licensed service cooperatives.

Successful research prompts farmers to organize Ethiopia’s first community-managed animal-health services to ensure sustainable delivery of pour-on technology to protect their cattle from disease.
The International Plant Genetic Resources Institute (IPGRI) concluded the first phase of an ambitious project in 2005. The project, “Enhancing the contribution of neglected and underutilized crops to food security and to incomes of the rural poor,” perhaps the first of its kind conducted on a global scale, involves activities in eight countries that address the entire value chain, from conservation of genetic resources to cultivation by farmers, and on to food processing and final marketing to consumers. An evaluation for the International Fund for Agricultural Development (IFAD), which supported the project, concluded that it “delivered very substantial value in return for the grant received.”

The project met or exceeded its ambitious goals in too many ways to enumerate, but tracing the benefits that flowed from a single activity is instructive. In the Kolli Hills of the southern Indian state of Tamil Nadu, the project worked through the MS Swaminathan Research Foundation with self-help groups established by farmers who had abandoned local millet varieties in favor of the cash crop cassava. Diets and health had suffered because millet is much more nutritious than the substitutes bought with the cash from cassava, and the sustainability of local farming systems was at risk.

Research found that one reason farmers had abandoned millet was the long hours of hard labor required to process it for consumption. The project introduced to the self-help groups mini-mills that do in 10 minutes what had taken a woman 2 or 3 hours to do by hand. The mini-mills both reduced drudgery and spurred enterprise as families established themselves as specialist mini-millers. Paradoxically, labor-saving devices increased employment as the ability to process millet for sale boosted demand, which farmers met by employing more farm labor. Family disposable income grew with higher grain sales and the savings that accrued as home-grown millet reduced household spending on food. Farmer demand for high-quality seed of specific varieties created opportunities for seed-producing specialists.

In Bolivia, an IFAD evaluation noted the unforeseen benefits of partners’ working together. When people from the agroindustrial firms that process Andean grains such as quinoa met the farmers who grow them, they realized that one reason grain was delivered dirty and of poor quality — and so expensive to process — was that farmers harvested it onto the ground. The firms simply supplied farmers with tarpaulins and shared their processing savings with them, improving farmers’ income.

Scientists also benefited. In India, university researchers learned to modify their “ideal” recommendations to accommodate the preferences of local farmers, whose needs often differ from those of an experimental farm. Farmers also learned to adapt the advice they received, and many who were not officially part of the project successfully emulated their neighbors.

Constraints on growing underutilized crops may occur anywhere along the value chain, and simple solutions can be surprisingly effective.

The evaluation had high praise for IPGRI’s “light touch” in managing a complex, global project and the professionalism of the regional implementing partners.
Developing new crop varieties is becoming simpler, more efficient and less expensive thanks to the International Crop Information System (ICIS, http://icis.cgiar.org), a general information-management system for crop improvement. Early development arose from collaboration convened by the International Maize and Wheat Improvement Center (CIMMYT by its Spanish acronym) and the International Rice Research Institute (IRRI) in the 1990s.

More recently, IRRI has led an expanded collaborative effort to develop ICIS as an open-source global public good for managing information in gene banks and seed inventories and for tracking intellectual property associated with germplasm transfer and use. The effort involves the International Center for Agricultural Research in the Dry Areas (ICARDA) and the International Center for Tropical Agriculture (CIAT by its Spanish acronym); national agricultural research systems in India, China, Philippines and Thailand; advanced agricultural research institutes in Australia, Canada and United States; and private sector companies in Australia, Netherlands and Singapore.

Scientists at the new joint facilities are developing a single crop information system and comparative biology infrastructure for rice, Philippines and Thailand; CIAT for beans; ICARDA for barley and chickpea; and private companies in Europe, Australia and Asia for rice, wheat, canola and vegetables.

ICIS operates by first being customized for a particular crop and breeding program and then managing information using system applications that track pedigree; manage nomenclature, characterization and evaluation; and permit the production of field books and reports facilitating selection and evaluation. The International Rice Information System (www.iris.cgiar.org) and the Global Wheat Information System (http://gwis.lafs.uq.edu.au) are examples of ICIS customized for rice and wheat.

Having decided in 2005 to pursue an alliance in research informatics, IRRI and CIMMYT established in January 2006 a joint Crop Research Informatics Laboratory (CRIL) by amalgamating staff and new facilities at CIMMYT with an existing unit at IRRI. One major thrust of CRIL will be adapting and developing ICIS for use in the maize and wheat projects of CIMMYT and its partners.

“After several years of talking about a common platform for developing new rice, wheat or maize varieties, we are now ready for real-world implementation,” says IRRI Director General Robert S. Zeigler. “Because all three are cereals and so share a range of common characteristics, this will reduce the time needed to develop new crop varieties and the cost. Particularly exciting is that this platform will be useful for other crops — often referred to as ‘orphans’ — that have yet to benefit from significant investments in genomics research. And, as we expand our data coverage, research in areas such as natural resource management and climate change will benefit from our combined capacities.”
Recent surveys in 50 cities across Asia, Africa and Latin America show that wastewater irrigation is a common reality in three-quarters of them. Poor farmers in urban and peri-urban areas rely on untreated but nutrient-rich wastewater to grow cash crops for a living. Wastewater irrigation supports a quarter of all vegetable production in Pakistan and nourishes 60–100 percent of the perishable vegetables consumed in most cities in most areas of sub-Saharan Africa. Wastewater irrigation provides jobs and incomes for traders who market the produce, input suppliers and other service providers. In sub-Saharan Africa, women in particular benefit, as in many African countries more than 95 percent of vegetable vendors are women.

However, untreated wastewater carries many health risks. The International Water Management Institute (IWMI) and partners in Africa and South Asia are looking at how wastewater can be safely used, maximizing the benefits of this resource while minimizing its risks to farm families and consumers. Research shows that washing vegetables with the correct salt solution, combined with appropriate sanitation and hygiene, can reduce health risks. In addition, on-farm adaptations such as using safer irrigation techniques, improved shallow wells, low-tech water filters and sedimentation methods can help safeguard public health.

The World Health Organization (WHO) of the United Nations developed guidelines for wastewater use in 1973 and 1989. These guidelines were influential in many developed countries, but IWMI research showed that they had much less impact in developing countries where using wastewater irrigation is an important livelihood strategy.

In 2002, as WHO launched a review and revision of the guidelines, IWMI invited its representatives to an international workshop organized on the topic with Canada’s International Development Research Centre. The resulting joint Hyderabad Declaration on Wastewater Use in Agriculture recognized the value of wastewater to farmers in low-income countries and recommended improving the practice of wastewater use in agriculture by reducing the risks associated with it. Subsequently, several publications appeared from IWMI, WHO and the authors of the new guidelines. IWMI became, with a panel of internationally recognized experts, further involved in formulating the new guidelines through expert consultations. The guidelines will be finalized and launched in September 2006.

Richard Carr, WHO project coordinator for the new guidelines from 1999 to 2005, reports that the guidelines were positively influenced by IWMI through the Hyderabad declaration and publications, correspondence and collaborative articles involving the Institute.

“Because of IWMI, the guidelines include greater consideration of livelihood issues,” he adds. “They also benefited from practical studies of real-life situations with regard to vegetable washing, and from case studies in Ghana, Senegal, Kenya, India and other countries. The guidelines emphasize the beneficial aspects of wastewater for many poor communities, citing research conducted by IWMI in India, Pakistan, and other countries. The widespread use of wastewater in agriculture is highlighted, as is the need for practical ways to safeguard health protection measures that are applicable to low-resource settings.”

Growing vegetables with wastewater offer benefits and pose risks, as in the market in Hyderabad.
Infrared spectroscopy (IR) detects minute differences in soil composition and structure, providing precise, timely information about how to improve depleted soils and boost crop productivity. Scientists at the World Agroforestry Centre (ICRAF), cooperating with private sector researchers at Analytical Spectral Devices of the United States and the German company Bruker Optik, have adapted the technology to African farm conditions. IR is currently being used in western Kenya as part of the Millennium Villages Project and in a World Bank initiative to halt land degradation and restore thousands of hectares of degraded farmland.

Today, IR instruments the size of suitcases cost US$70,000, or little more than 5 percent of the cost of equipping a conventional soil analysis laboratory. Handheld IR units may be available within 3 years, allowing the technology to help farmers in much the same way that mobile phones provide service access without costly infrastructure. World Food Prize-winner Pedro Sanchez predicts that, within a decade, agricultural extension providers in many countries will be using handheld IR equipment as their principal tool for soil and plant analysis.

"With IR, we have a tool that can collect data on soil quality and plant nutrition from thousands of locations, georeference it, and predict quickly and inexpensively how improved crop varieties will respond to fertilizer at a given location," says Dr. Sanchez, director of the United Nations Millennium Project’s Hunger Task Force.

The effectiveness of the technique was first demonstrated in 2000 when ICRAF scientists discovered massive soil erosion plunging into Lake Victoria. The problem was all but unrecognized until IR made possible a cost-effective diagnostic survey. In a more recent test, IR pinpointed soil degradation in the 3,500-square-kilometer basin of the Nyando River and helped Kenyan scientists set targets for a World Bank and Global Environment Facility initiative.

IR uses light for rapid, nondestructive analyses of soil and plant materials. Reflectance from a soil sample is collected across a range of IR wavelengths to create a digital scan, from which a reflectance fingerprint is obtained, allowing technicians to detect multiple soil properties. The technique is fast and economical does not require the costly chemicals used in conventional soil analysis. Tests have shown that IR is highly effective when used with global positioning systems and satellite sensing to produce inexpensive maps that can pinpoint areas with soil and plant nutrition problems.

Keith Shepherd, project lead scientist, explains that a single IR instrument allows rural laboratories to analyze not only soils and crops, but also a range of agricultural inputs and products, including manure, animal feed, grain and tree products. He points out that the equipment is easy to maintain and operates at almost no cost, compared with more than $50 per sample in a conventional laboratory.

IR equipment was recently installed in a rudimentary laboratory at Mali’s Institut d’Economie Rurale. IR technology is currently slated for use in India, Mozambique and Uganda.
The southern African country of Malawi is one of the world’s poorest. This increasingly crowded country of 12.1 million people is prone to natural disasters, including both drought and flooding. Malnutrition is a leading cause of child mortality.

Limited resources and low farm fertility are serious problems. The country’s single major natural resource, agricultural land, is under severe pressure as slash-and-burn cropping continues under rapid population growth, dramatically shortening fallow time for restoring exhausted soil. Many Malawians must strive to meet all their family needs with less than 1 hectare of land.

To make that land more productive, the WorldFish Center, working with Malawi’s Department of Fisheries, has pioneered locally appropriate techniques of integrated aquaculture and agriculture (IAA), under which farmers set aside a small portion of their land for fish farming, recycling nutrients between ponds and fields to improve yields in both.

In 1986, when WorldFish began its research and on-farm trials in Malawi, the country had only 400 fish farmers. Today it has more than 4,000. The spread of IAA has boosted fish pond output by tenfold nationally, from 90 tons per years to more than 1,000. Between 1996 and 2001, aquaculture productivity in individual ponds has improved by some 22 percent. In rural areas that practice IAA, child malnutrition has fallen by about 15 percent because farmers are able to feed their families fish with high-quality protein and essential micronutrients. Nationwide, per capita fish consumption has surged by a massive 160 percent.

IAA farms are more productive, sustainable and profitable than traditional farms. Raising farm productivity by 10 percent, IAA has boosted farm income by 28 percent and technical efficiency by nearly half.

The techniques used in IAA are simple and low-cost. Kitchen and farm wastes — including maize bran from the main traditional crop and manure from goats and chickens — provide food for fish species such as tilapia. Pond water is available in the dry season to irrigate maize, cabbage and tomatoes. Pond sediments make great fertilizers for crops, and some farmers have found that depleted ponds are good for growing rice. Farmers also grow cash crops like bananas and guava on the banks of their ponds.

In addition to storing water for irrigation, ponds recharge local aquifers as water percolates through the soil. WorldFish has found that IAA farms in Malawi are 18 percent more productive under drought conditions than traditional farms.

One reason for the scheme’s success has been its inclusive and participatory nature. The IAA project engages farmers directly, using resources readily available to them and recognizing their constraints. The return on investment has been an impressive 15 percent. In other words, every US$100 invested in developing and disseminating IAA generates an annual return of $115.

IAA is being adopted by other countries in sub-Saharan Africa, notably Zambia, Mozambique, and Cameroon, promising to improve livelihoods and nutrition in a region where many live on only $1 a day.