CIAT in Africa

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Progressive Science to Improve Rural Livelihoods

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The World Summit on Sustainable Development, held last year in Johannesburg, South Africa, signaled the return of agriculture to a central place in development planning and programs. Despite acrid debates about issues such as the effects of agricultural subsidies in industrialized countries on trade opportunities for the developing world, the Summit's message was clear: Sustainable tropical agriculture is vital for achieving food security, reducing poverty, and protecting the environment; and it is closely linked to other high-priority issues, including water, energy, health, and biodiversity.

The International Center for Tropical Agriculture (CIAT) pursues a progressive R&D program in Africa that helps rural communities build sustainable livelihoods, based on competitive agriculture, healthy agroecosystems, and rural innovation. In pursuit of these goals, we work closely with national institutions, NGOs, and the private sector, and we use participatory methods that offer rural people an active role in devising better ways to improve crops, build rural agroenterprises, and manage soil fertility, pests, and plant diseases.

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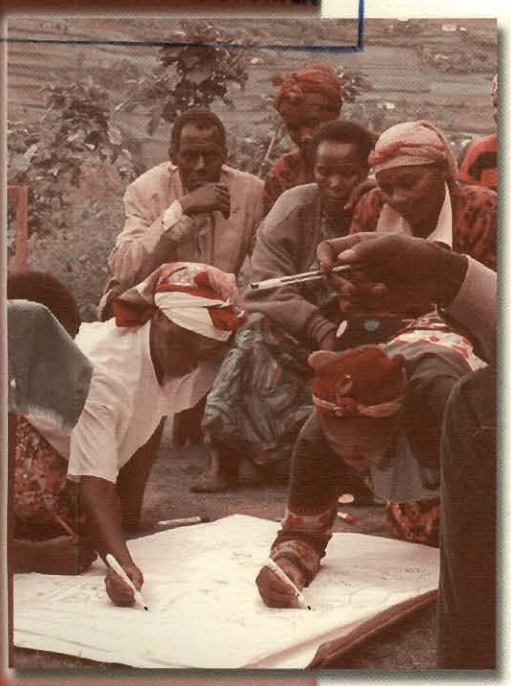


This document gives an overview of CIAT's R&D program and explains how our scientists in Africa are helping meet some of the continent's most urgent challenges.

Solutions in the Soil

One of the most pressing problems of African agriculture is the widespread decline in soil fertility. About a half billion hectares of the continent's agricultural land are already moderately or severely degraded, greatly undermining the efforts of African farmers to improve their livelihoods through more intensive production. CIAT has done much to help reverse the soil fertility decline and has recently embarked on new initiatives with international and national partners that promise to deliver much more.

New practices and tools

Since the early 1990s, CIAT scientists have been identifying and testing new soil management practices, using participatory approaches, with farmers in several eastern African countries. This work has demonstrated the value of various legumes—canavalia, mucuna, lablab, crotalaria, tephrosia, and vetch—for improving soil fertility, among other uses.

In order for farmers to make sound decisions about when and where to employ new soil management technologies, they need a reliable way to monitor soil quality. To help them do that, CIAT and various national partners have developed a new decision-support tool in the form of a training guide. The guide explains how to elicit, organize, and rank farmers' perspectives on soil quality and integrate them with those of soil scientists.

Developed originally in Latin America, this and other decision-support tools have been adapted to conditions in eastern Africa through training events held in Uganda and Tanzania. These events were conducted jointly by CIAT; the African Highlands Initiative (AHI), coordinated by the International Centre for Research in Agroforestry (ICRAF); the CGIAR Systemwide Soil, Water, and Nutrient Management (SWNM) Program; and the Kenya-based Tropical Soil Biology and Fertility Programme (TSBF).

An open alliance

On the foundation of that and other collaborative efforts, CIAT, the TSBF Programme, and ICRAF recently

established the Alliance for Integrated Soil Fertility Management (ISFM) in Africa. In a prior step toward forming the alliance, the TSBF Institute of CIAT was created under an agreement signed in December 2001. Subsequently, CIAT and ICRAF agreed on terms for a wider arrangement that will fully integrate the soils research of the three organizations.

Scientists from the alliance's three founding partners met in early March 2002 with technical advisers from interested donor agencies for a 3-day strategy-development workshop. The event was sponsored by the Rockefeller Foundation at its Bellagio Study and Conference Center in Italy. Afterwards, a working group produced a synthesis of the workshop presentations, entitled "Soil Fertility Degradation in Sub-Saharan Africa: Leveraging Lasting Solutions to a Long-Term Problem." Workshop participants identified a series of actions that need to be taken, organized under five headings:

1. Empowering farmers to apply ISFM practices on a larger scale—from individual farm plots and households to entire landscapes and communities.
2. Finding ways to translate new knowledge from strategic research on soil carbon and nutrient cycles into practical soil management measures that boost and sustain agricultural productivity.
3. Devising new management practices that enhance the soil's ecosystem functions, such as carbon storage, which reduces emissions of greenhouse gases.
4. Managing soil organisms and monitoring their valuable contributions to human welfare and agroecosystem health.
5. Strengthening networks of scientists, development professionals, and farmers through training, partnerships, and information sharing.

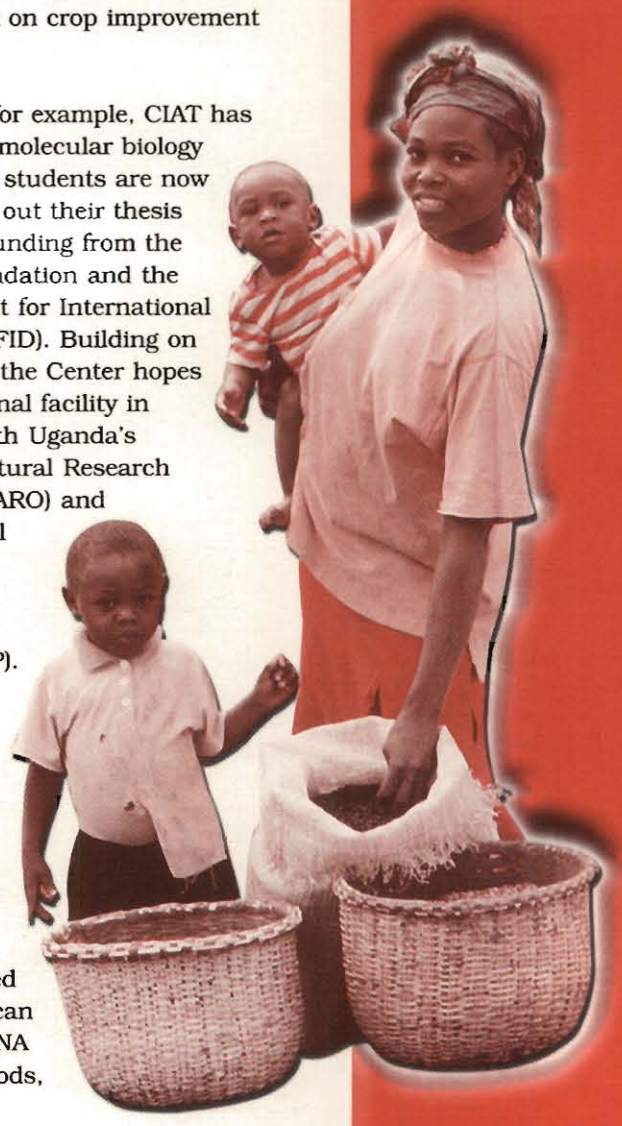
To achieve rapid advances on all of these fronts, the three founding members of the alliance will combine their R&D experience, networks, and partnerships for joint implementation of ISFM approaches. The alliance will also serve as a hub for effective collaboration with regional networks and major development programs in Africa.

Releasing the Power of Modern Plant Breeding

In order for small farmers to adopt new soil management practices, these must be accompanied by superior crops that respond well to improved soil fertility, thus enabling farm families to put more food on the table and produce a surplus for the market. But new crop varieties must also be able to grow reasonably well under less favorable conditions, including low soil fertility, drought, and pest and disease attack.

To help apply the power of modern plant breeding in Africa, CIAT improves three crops—common bean, cassava, and tropical forages—that are especially important for poor people living in marginal environments. At the same time, Center scientists help national partners acquire new knowledge and skills that make their work on crop improvement more effective.

In Uganda, for example, CIAT has helped set up a molecular biology lab, and African students are now using it to carry out their thesis research, with funding from the Rockefeller Foundation and the UK's Department for International Development (DFID). Building on this experience, the Center hopes to create a regional facility in collaboration with Uganda's National Agricultural Research Organisation (NARO) and the International Network for the Improvement of Banana and Plantain (INIBAP). This will better enable African researchers to integrate biotechnology techniques into problem-solving research. CIAT scientists have already organized training for African colleagues on DNA extraction methods,



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on methods for molecular characterization of plant pathogens, and on the use of molecular markers in crop improvement.

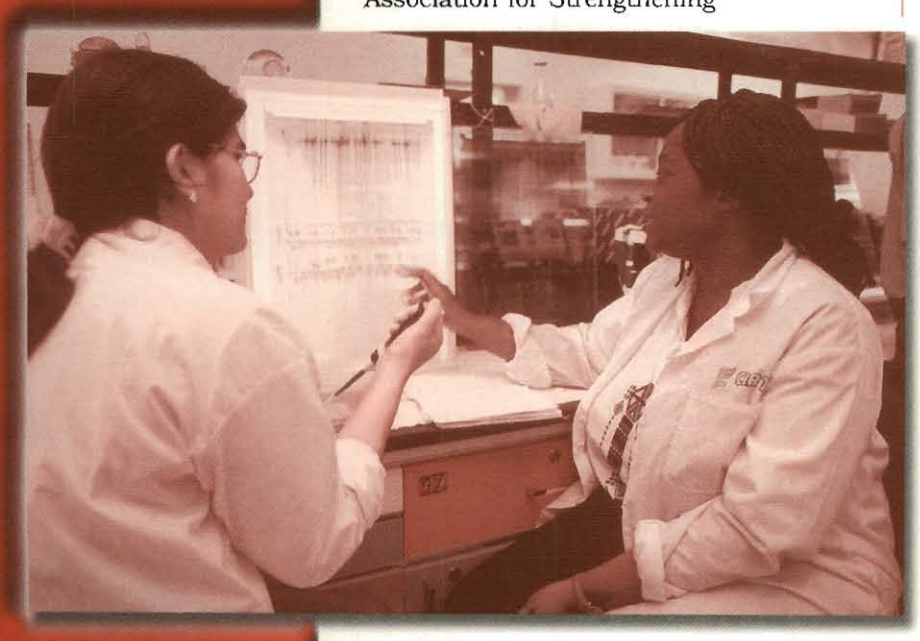
The Center has also worked hard to incorporate participatory plant breeding (PPB) into the improvement of several crops in Africa. In recent years our work on PPB has received a boost from the CGIAR Participatory Research and Gender Analysis (PRGA) Program, which the Center coordinates. One British-funded PRGA project, for example, has helped stimulate interest in PPB by assessing the effectiveness of this approach with African national programs.

This kind of support and collaboration is vital for building on the achievements and activities described below.

Common bean

Since the mid-1980s, CIAT scientists have introduced improved bean seeds from tropical America—where the crop has its two natural centers of genetic diversity—into the midaltitude and highland areas of central, eastern, and southern Africa.

This work takes place through the national R&D programs that make up the Pan-African Bean Research Alliance (PABRA). The alliance encompasses the Eastern and Central Africa Bean Research Network (ECABREN) and the Southern Africa Bean Research Network (SABRN). These networks, in turn, belong to two regional organizations—the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the Southern Africa Development Council (SADC). The networks receive financial support through a donor consortium that includes the Canadian, Swiss, and US governments.



Nutritionists characterize the common bean as a nearly perfect food because of its high protein content and generous amounts of fiber, complex carbohydrates, and other dietary necessities. New varieties thus offer a powerful means of combating malnutrition in the region. Moreover, as Africa's cities expand, market demand for beans is rising rapidly, creating opportunities for farmers to increase their incomes by producing both grain and high-quality seed. And since the crop is grown mainly by small women farmers, they reap most of the benefits.

Among the first improved beans to win African farmers' allegiance were climbing types of Mexican origin. Introduced in Rwanda during the mid-1980s, the new seeds had been adopted a decade later by about half of Rwandan farmers. High yielding and resistant to disease, climbing beans offered the ideal food solution for a densely populated, land-scarce country.

By means of the regional bean networks, which feature innovative seed systems, climbing bean varieties have since spread to Burundi, Congo, Ethiopia, Kenya, Tanzania, Uganda, and Zambia. Elsewhere in the region, new bush-type bean varieties are also strengthening food security and helping farmers cater to markets.

To provide African partners with new options for helping farmers, CIAT scientists are developing beans with tolerance to drought and low soil fertility. They are also identifying bean germplasm with higher iron and zinc content, as part of a new multi-institutional program of the CGIAR to reduce micronutrient deficiency, which mainly afflicts women and children. If, as bean geneticists expect, the content of these micronutrients can be increased by 50 percent, the nearly perfect food will do even more to improve human nutrition in Africa and elsewhere.

To also help farmers become more competitive, the African bean networks have adopted a new market-driven strategy for bean breeding. Through partnerships between national research institutes, universities, farmer associations, private companies, and NGOs, the networks are tailoring new varieties more closely to the diverse demands of local food markets, inter-African trade, and more distant export markets.

Cassava

This starchy root crop is vital for Africa's food security and also presents new options for linking small farmers to markets through value-added processing. To help strengthen and broaden the crop's development role on this continent, CIAT cassava scientists have built an active program of breeding and germplasm exchange in collaboration with national partners and the Nigeria-based International Institute of Tropical Agriculture (IITA).

One of CIAT's key functions in this work is to inject Latin American "blood" into Africa's cassava gene pool. It does so by providing IITA with advanced breeding materials and samples of cassava wild relatives. Recent experience—particularly with drought-tolerant cassava from Northeast Brazil—has amply shown the value of introducing into Africa genetic resources from cassava's tropical American center of origin.

In order for IITA scientists to employ this material, though, it must be resistant to cassava mosaic disease (CMD), which at this point occurs only in Africa and is the continent's most damaging disease of the crop. IITA provides the CMD-resistant genotypes needed to introduce this trait into CIAT germplasm.

In addition, the two centers are jointly developing procedures for molecular marker-assisted selection that will increase the pace and reduce the costs of developing CMD-resistant cassava. A further aim is to combine CMD resistance with traits, such as higher content of beta-carotene (the precursor of vitamin A), that will raise cassava's nutritional value.

Tropical forages

Recent experience in Latin America and Southeast Asia has shown that improved tropical forage grasses and legumes (some of them derived from materials indigenous to Africa) are highly effective for intensifying small-scale livestock production, while at the same time protecting soil and other natural resources. Their appeal to farmers lies in their high productivity and nutritional value and adaptation to stresses, such as drought and acid soils.

So African farmers, too, can gain better access to this technology. CIAT and the International Livestock Research Institute (ILRI) are expanding their collaborative forage research in the region. In one new initiative, they will concentrate on improving dairy systems in eastern and southern Africa, with a view to strengthening food security, raising incomes, and improving natural resource management. Because of land scarcity and HIV/AIDS in the peri-urban areas targeted by this work, scientists will concentrate on developing labor-saving technologies, and they will employ participatory approaches that involve men and women of all ages.

Another initiative will link Africa with cutting-edge research on other continents, aimed at boosting farmer adoption of tropical forages. Drawing on the wealth of data and experience already available as well as on local knowledge, scientists are developing computer-based information systems that help R&D professionals decide where and how a wide array of tropical forages can best be integrated into livestock production systems.

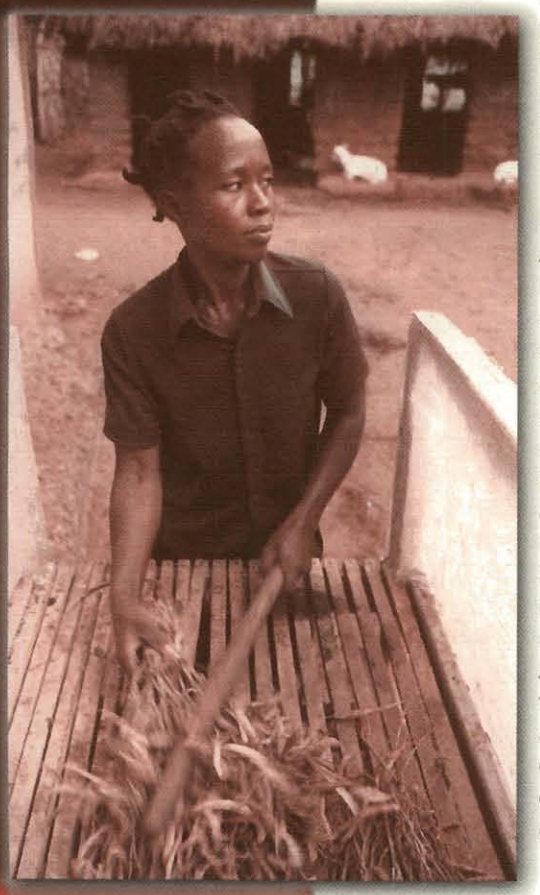
Linking Farmers to Growth Markets

Once rural communities have bolstered their food security and raised incomes by adopting new crop varieties, the improved crops can then serve as entry points for economic development. Through rural processing, for example, farmers and local entrepreneurs can add value to agricultural produce and thus compete more effectively in growth markets. Moreover, as new agroenterprises emerge, rural communities will be better able to invest in preserving the natural resources on which rural livelihoods depend.

Small-scale seed enterprises

Private seed companies in Africa tend to focus on a few highly commercial crops and on a few varieties for which there is a large market. As local demand for the many new varieties of various crops takes off, farmers will gain new economic opportunities in small-scale seed production. During recent years CIAT research has shown that, with adequate support, small farmers are capable of producing high-quality seed of improved varieties. In this way they can contribute importantly to crop intensification while preserving agrobiodiversity.

Based on that experience, CIAT has developed training materials on the principles and procedures of establishing small-scale seed enterprises. In addition to raising farm income and promoting the adoption of improved varieties, these should make agriculture more resilient in the face of natural disasters. During times of drought, for example, farmers will have reliable, local sources of seed to replenish damaged supplies, instead of receiving poorly adapted seed from elsewhere through standard seed and tools emergency programs. As part of its effort to promote alternative approaches to strengthening seed systems, CIAT and other Future Harvest centers are working together in Africa to provide advisory services to the growing number of national programs and NGOs interested in this work.



Sharing Latin American experience

In search of new opportunities for Africa's rural communities to achieve a more competitive, market-oriented agriculture, CIAT is expanding its work on agroenterprise development in the region. In doing so we can draw on many years of experience in helping Latin American farmers add value to traditional crops, analyze market opportunities, and diversify into new enterprises.

One vehicle for sharing that experience is the Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA). Established in 1999, CLAYUCA unites private and public sector organizations from seven countries of the Americas with two international centers, CIAT and France's Center for International Cooperation in Agricultural Research for Development (CIRAD). The common cause of these diverse organizations—one they consider highly relevant to Africa as well—is the promotion of cassava as an entry point for local industrial development.

As a further means of strengthening its work on rural agroenterprise development in Africa, CIAT has placed a senior specialist in the region. His primary tasks are to: (1) gauge demand and identify partners for this work; (2) adapt and apply new knowledge and tools (e.g., for designing agroenterprises that link small farmers to growth markets) through action research; and (3) scale up the work through wide dissemination of R&D products and intensive training for staff of African government organizations and NGOs.

New alliances and new markets

Good progress is being made in all three of those tasks. For example, CIAT has recently entered into "learning alliances" with Catholic Relief Services (CRS) and Foodnet, an ASARECA-sponsored regional network, which is coordinated by IITA and funded by the US Agency for International Development (USAID). In cooperation with CRS, Foodnet, and Uganda's NARO, CIAT scientists have helped organize courses in eastern Africa on agroenterprise development. With help from local organizations, farmer groups have begun developing the agroenterprises they consider most promising.

In addition, CIAT and CLAYUCA have forged a broad agreement with IITA for collaboration with the International Potato Center (CIP) and national partners through the USAID-funded Southern Africa Root Crops Research Network (SARRNET). A first challenge is to establish a consortium of public and private sector organizations—based on the CLAYUCA model—for supporting sweet potato and cassava R&D. Toward

this end contacts have been made with industries in Kenya, Malawi, and Tanzania that are interested in using cassava and sweet potato products.

Another key task is to gain a better understanding of the region's market opportunities. For this purpose surveys are being conducted to characterize the market chain for cassava and sweet potato in Malawi, Tanzania, and Zambia. Researchers are also establishing pilot plants in several countries to develop processing technologies (e.g., to make cassava and sweet potato into poultry and cattle feed) that are appropriate for farmers and industry. Most important, the collaborating institutions will form teams of trained professionals who can pursue market-driven strategies for agricultural development across the region.

Integrated Pest and Disease Management

With a more intensive, market-oriented agriculture comes the risk of more intensive pest and disease pressures. If Africa's small farmers are to be competitive over the long term, they must acquire new knowledge, skills, and tools that help meet these threats without relying excessively on agrochemicals, monocropping, or single crop varieties, which only increase the vulnerability of agriculture in the face of evolving pests and diseases and global climate change.

Experience and achievements

CIAT has a long history of helping African farmers combat bean pests and diseases. In the African highlands, the battle has often been waged in exactly the same places where soil degradation is most advanced. This is no coincidence. High population density and land scarcity in such areas has led to nearly continuous cultivation, reducing soil fertility and leaving bean crops more vulnerable to particular pests and diseases.

Fortunately, CIAT's experience in the region has shown that researchers, working in partnership with farmers and NGOs, can develop and widely disseminate integrated pest management strategies. These rely partly on resistant germplasm but also on improved crop and soil management practices. In Rwanda and subsequently Kenya, multidisciplinary teams working under AHI have developed effective strategies for halting major outbreaks of bean root rots and bean stem maggots. Using a predictive model, other countries are anticipating these pest problems through approaches borrowed from similar environments elsewhere in the region.

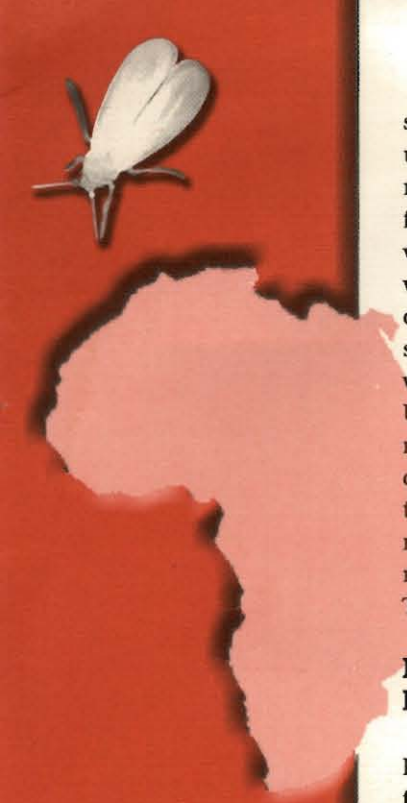
In northern Tanzania farmer groups and the national bean program, with support from CIAT, are successfully combating the destructive bean foliage beetle by combining local knowledge (of biopesticides, for example) with researchers' findings on such practices as rotation of beans with maize or sunflower. The participatory methods underlying this work enable farmers to help neighboring communities adapt new technologies to their own circumstances. With support from DFID, the approach is now being applied to other pest problems in several other African countries.

Battling the whitefly

Like its research on soils, CIAT's work on integrated pest and disease management increasingly depends on multi-institutional alliances for combating major threats to agriculture in Africa and beyond. One particularly alarming problem is the whitefly and the many viruses it transmits, affecting numerous crop species across the tropics. Researchers are presenting a united front against this threat through the CIAT-coordinated Tropical Whitefly Integrated Pest Management (TWF-IPM) Project, which forms part of the CGIAR's Systemwide IPM Program.

In Africa the global initiative operates through two subprojects. One confronts whitefly-transmitted viruses affecting tomatoes and other vegetable crops in mixed cropping systems of eastern Africa, while the other deals with such viruses attacking cassava and sweet potato in nine countries across the continent.

The urgent task of the first subproject is to head off a crisis



scenario of the sort that has already unfolded in Mexico and Central America, resulting in dramatic reduction of farmers' incomes from export-oriented vegetable production. Scientists are working toward this end by using common research methodologies and sharing experience across regions. In the work on cassava, IITA scientists and Ugandan colleagues have succeeded in mitigating a major food disaster in that country, caused by a severe epidemic of the whitefly-transmitted CMD. The multipartner whitefly team is now repeating this success in Kenya and Tanzania.

Empowering Farmers Through Participatory Approaches

Participatory methods for action research figure prominently in the Center's approach. Such research, conducted with partner organizations in selected rural communities, is our primary means of ensuring that valuable lessons learned about improving food security, building agroenterprises, and managing natural resources are widely relevant and can be readily adapted and applied in other communities.

Particularly useful innovations and insights have come from Participatory Research for Improved Agroecosystem Management (PRIAM). Funded originally by the Rockefeller Foundation, this project was later incorporated into ECABREN. Working with national research teams, project staff helped form farmer research groups in Congo, Ethiopia, Kenya, Madagascar, Malawi, Rwanda, and Uganda, focusing on variety improvement, soil management, and other tasks. Based on this experience, Kenyan scientists are now making farmer research groups and other participatory approaches a prominent feature of work done by their country's regional agricultural research centers.

The pioneering efforts of PRIAM have continued under a new alliance of the PRGA program with AHI in cooperation with national institutions and NGOs. From this work we have derived important lessons about the selection, performance, and monitoring of farmer research groups—lessons that provide a basis for rapid spread of participatory methods in Africa.

Meanwhile, CIAT has been consolidating its expertise with participatory research in Latin America, Africa, and Asia under a new Rural Innovation Institute (RII), based at our headquarters in Colombia. Center scientists believe that farmer research and enterprise groups can serve as engines for local development, better enabling rural communities to combat poverty.

Under a related initiative, called "Enhancing Rural Innovation," we are applying best practices in rural agroenterprise development, farmer experimentation, and natural resource management with various partner organizations, such as Africare in Uganda and the Traditional Irrigation and Environmental Development Programme (TIP) in Tanzania. Supported by the Belgian and Canadian governments, this work will help ensure that farmers gain, not just easier access to research products, but a stronger voice in their development.

New Partnerships for Demand-Driven Research

CIAT works hard to ensure that its research complements that of other international centers and closely matches the priorities of African institutions. For that reason Center staff played an active role in a series of recent workshops, whose purpose was to draw up an R&D agenda for the centers' activities in Africa through an Africa-led process.

That is also why CIAT invited a group of African research directors from Malawi, Mozambique, and Uganda in early 2001 to visit CIAT headquarters in Colombia. Though no strangers to the Center's work, they wanted to see what new things we could offer their continent. They seemed pleased to confirm that the Center is well along in building an integrated R&D program for Africa that rises to the dual challenge of reducing poverty while conserving natural resources. Among other things, the African directors learned that this program is improving the region's capacity to conduct problem-solving biotechnology research, promote rural agroenterprise development, and protect soil and crop health through demand-driven research.

A key outcome of the meeting was the decision to hold two workshops in Africa that gauged research demand and otherwise laid the foundations for new projects that CIAT undertakes with African partner institutions. Various Center projects, together with the PRGA and SWNM programs, are putting together project ideas with African colleagues under the rubric "rural innovation and enterprise development." The aim is to create a competitive, ecologically sound agriculture by blending formal science with farmer experimentation.

The World Summit on Sustainable Development recognized the importance of this kind of approach in proposing a new multi-institutional partnership on ecoagriculture. It is bringing together farmer organizations and R&D institutions to identify and promote best practices for strengthening food security, raising incomes, and protecting biodiversity and other natural resources.

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Solutions That Cross Frontiers

The International Center for Tropical Agriculture (CIAT) is a not-for-profit organization that conducts socially and environmentally progressive research aimed at reducing hunger and poverty and preserving natural resources in developing countries.

CIAT is one of 16 food and environmental research centers working toward these goals around the world in partnership with farmers, scientists, and policy makers. Known as the Future Harvest centers, they are funded mainly by the 58 countries, private foundations, and international organizations that make up the Consultative Group on International Agricultural Research (CGIAR).

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Contact:

Roger Kirkby
CIAT Africa Coordination
Kawanda Agricultural Research Institute
P.O. Box 6247
Kampala, Uganda
Phone: +256 (41) 566089, 567470, or 567670
Fax: +256 (41) 567635
E-mail: r.kirkby@cgiar.org