

CIAT in Africa

Applying Modern Science to Improve Traditional Livelihoods

This brochure gives an overview of CIAT's research programme in Africa, of what we have achieved and what we still hope to do. It explains how our scientists are helping to meet some of the continent's most urgent developmental challenges, not only by providing new technologies and other innovations, but also by helping poor people to help themselves. Encouraging farmers to try new things is creating a new generation that can analyse its own problems and access or design its own solutions to them. In other words, we are empowering people to build and sustain their livelihoods.

The African research programme of the International Centre for Tropical Agriculture (CIAT) helps rural communities in the region build sustainable livelihoods. It does this by fostering strong, mutually beneficial relationships among national research institutions, non-government organisations, the private sector and, most importantly, farmers themselves. By working in this way - using a bottom-up approach - CIAT can meet three crucial challenges that people in Africa face: enabling rural innovation, improving the management of tropical agro-ecosystems; and developing the potential of agricultural biodiversity while ensuring better access to new crop varieties.

Africa is not poor in natural or human resources; it is a continent of promise and potential. Yet, of the 650 million or so people living in sub-Saharan Africa, more than 200 million are undernourished. It is a sad irony that as many as half of these are farmers, landless labourers or others who earn their living from the natural resource base. In Africa, more than in any other developing region, increasing and sustaining the productivity of agriculture is central to achieving the Millennium Development Goal of halving hunger and poverty by 2015. The question facing CIAT and its partners is how can science and technology contribute?



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Roadmap to a Uniquely African Green Revolution

The importance of agricultural research and development (R&D) in Africa is stressed in a 2004 report entitled *Realizing the Promise and Potential of African Agriculture*, from the Inter-Academy Council (IAC) Panel on Agricultural Productivity. Commissioned by UN Secretary-General Kofi Annan, the report notes that investment in agricultural R&D is a fundamental determinant of agricultural productivity and, in turn, of economic growth. Enhancing African agriculture is vital for reversing the region's continuing slide into poverty and hunger and setting it on the road towards achieving the UN Millennium Development Goals.

While it may be tempting to try to emulate earlier agricultural successes elsewhere in the world, CIAT knows that Africa needs its own solutions. As the IAC report says, the original Green Revolution experienced in Asia and Latin America, based on a few high-yielding staple food crop varieties that can be grown under irrigation, is not applicable here. African agriculture is radically different from Asian agriculture in several ways. First, it is mainly rainfed, not irrigated — and highly diverse, with no single farming system dominant. Second, African soils tend to have poor and declining fertility. Third, women play a stronger role in household food security. And, finally, the political and economic environments are often not conducive to thriving agricultural productivity. Competitive markets for produce are few, labour productivity remains low, and both rural infrastructure and agricultural R&D suffer from chronic under-investment.

To address the situation and create what the IAC report calls 'Africa's Rainbow Revolution', we must attack simultaneously on many different fronts. To this end, CIAT has engaged with national and international

organisations to form wide-ranging and inclusive partnerships around three core areas: enabling rural innovation, managing natural resources and developing and accessing agro-biodiversity.

Enabling Rural Innovation

One of the crucial recommendations of the IAC report is that productivity improvement strategies should be market-led. Improving the market access and competitiveness of smallholder farmers has become one of the most important and active areas of CIAT's work in Africa.

Globalisation presents today's farmers with new threats as well as new opportunities. Increasing competition, coupled with the volatility of markets, could all too easily push already disadvantaged regions, countries or groups into deeper poverty and hunger.

Poor rural communities must be able to innovate quickly but soundly if they are to avoid this fate. Experience has shown that, by forming groups and small businesses, small-scale farmers can exploit the new opportunities that arise in domestic, regional and international markets. As farmers successfully experiment and learn, the community begins to acquire a collective capacity for continuous innovation that will improve livelihoods over the medium to longer term. Efforts to build this capacity fall under CIAT's Enabling Rural Innovation (ERI) initiative, which receives support from the government of Belgium, among others.

The Traditional Irrigation and Environmental Development Programme (TIP) in Tanzania initiated an ERI project in 2002. Starting with three water user groups in Lushoto, this local non-governmental organisation (NGO) tested and adapted different approaches to strengthening the capacity of farmers' organisations to exploit market opportunities. After two years, TIP created a Marketing and Agro-enterprise Development programme, incorporating ERI. In 2003, TIP was awarded a new grant to implement this



programme in a single district of Tanzania. Today, the programme covers 20 districts – a mark of its considerable success.

Decentralisation of government in Uganda has offered farmers a unique opportunity to have their say in the reform of local bye-laws governing agriculture and natural resources. The existing laws, imposed from a top-down perspective and marked by weak enforcement, were ineffective and largely irrelevant. With help from CIAT, the African Highlands Initiative (AHI) and national partners, farmer groups in Rubaya sub-country, Kabale district in the southwest of the country revised and reformulated these bye-laws. The result of the exercise is stronger social capital for collective action, greater participation of women in development, and better arrangements for managing key natural resources. Neighbouring communities and members of Parliament are now taking an interest in replicating the approach elsewhere.

Rural Innovation Institute

In 2002, CIAT brought together its expertise in participatory research, information management and agro-enterprises under the Rural Innovation Institute (RII) based at its headquarters in Colombia. To further strengthen our work on rural agro-enterprise development, CIAT's global programme is now managed by a senior specialist hosted by the National Agricultural Research Organisation (NARO) in Uganda.

Farmers are better able to seize opportunities if they understand the needs of the market and can adapt what they are doing to meet these needs. They can either add value to their existing crops, through processing or selling into new markets, or diversify into new, higher-value commodities. The experience of RII and its partners has shown that rural people can be empowered to become agents of their own change process, making their own demands on rural R&D service providers, articulating ideas for agricultural research to explore and becoming more resilient to the shocks inherent in dynamic markets.

The emergence of new agro-enterprises should encourage rural communities to invest in preserving the natural resources on which their livelihoods depend although this is a hypothesis that we as researchers are testing.

Empowering farmers through participatory approaches

Participatory methods for action research figure prominently in CIAT's African programme. This is our primary means of ensuring that the lessons learned about improving food security, building agro-enterprises and managing natural resources are widely relevant and can be readily adapted and applied in other communities. Farmers who have participated actively in the research process feel more ownership of research results and are more likely to employ the resulting new technologies.

Participation must be inclusive if it is to contribute effectively to rural innovation. Combining the views of all stakeholders – farmers, other community members, outside business entities, government and NGOs – gives a better idea of what direction to take to ensure equitable outcomes and to avoid, or at least attenuate, conflicts over the use of resources. One of CIAT's first steps in the innovation process is to encourage communities to look at themselves in a positive light, analysing their strengths and weaknesses rather than focusing only on their problems. This type of collective analysis should reveal a range of solutions that will be applicable to women as well as men, that will help the least-fortunate members of the community, and that will safeguard the environment in addition to raising productivity and incomes.

The programme's activities have demonstrated that community-driven participatory monitoring and evaluation (PM&E) can improve farmers' livelihoods by suggesting relevant and timely agricultural innovations. Through PM&E, communities can agree on what they need to do to achieve their objectives, what indicators they can use to assess progress, and what factors will make their projects succeed or fail.

Working initially in pilot sites with local partners, CIAT is making excellent progress in encouraging sustainable rural innovation in Africa. For example, in several countries we have entered into Learning Alliances with a leading NGO, the Catholic Relief Services (CRS), and Foodnet, sponsored by the

Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and coordinated by the Nigeria-based International Institute of Tropical Agriculture (IITA). In cooperation with CRS and Foodnet, CIAT scientists have helped organise courses in eastern Africa on agro-enterprise development that have helped set others on this development path.

With help from local businesses and organisations, farmer groups have begun developing the agro-enterprises they consider to be the most attractive. One potato-producing group in southwest Uganda targeted Nandos, a restaurant chain, as a potential buyer of its crop. Undeterred by the rigorous quality and quantity requirements, the Nyabyumba farmers group undertook a complete overhaul of traditional farming practices in order to become suppliers to first-world consumers. For this group, farming was no longer about producing a traditional product and hoping that traders would buy it; for Nandos, buying the farmers' products was business as usual, not charity.

Managing Natural Resources

A healthy ecosystem is a prerequisite for the sustainable development of agriculture. As noted by the IAC report, the continuous cropping of cereals without the use of inputs has, in combination with other factors, led to a widespread decline in soil fertility. This has become one of the most pressing problems of African agriculture: about a half billion hectares of the continent's agricultural land are already moderately or severely degraded, greatly undermining the efforts of farmers to improve their livelihoods.

Enriching and maintaining fertility

CIAT is working hard to help reverse the soil fertility decline. Since the early 1990s, CIAT scientists have identified new soil management practices and have been testing them in collaboration with farmers in several eastern African countries. This work has explored the value of various legumes that can improve the soil and prevent the build-up of pests and diseases at the same time as providing food and fodder, as part of an integrated approach to natural resource management.

Farmers need to be able to monitor the fertility of their soils if they are to manage them responsibly. To enable them to do this,

CIAT and various national partners have developed a set of decision-support tools in the form of training guides. For example, one guide explains how to elicit, organise and rank farmers' perspectives on soil quality and integrate them with those of soil scientists.

This decision-support tool was adapted to conditions in eastern Africa through training workshops in Uganda and Tanzania in late 2000 and early 2001 that were co-organised by CIAT and the African Highlands Initiative (AHI). Support was provided by the World Agroforestry Centre (ICRAF), the CGIAR's Systemwide Programme on Soil, Water and Nutrient Management (SWNM), and the Tropical Soil Biology and Fertility (TSBF) Programme.

A 21st century alliance

In December 2001, the TSBF Programme merged with CIAT to become the TSBF Institute of CIAT. Based in Nairobi, the Institute incorporated CIAT's own work on soil fertility to become the CGIAR's most significant concentration of expertise and resources in this area.

Like CIAT, the TSBF Institute encourages broad alliances and is partnered with a wide range of other groups in addition to several other CGIAR centres. Together, these organisations provide major inputs into the African Network on Soil Biology and Fertility (AfNet) and development programmes in Africa. They share a common approach to soil management that identifies the following priority actions:

1. Empower farmers to apply integrated soil fertility management (ISFM) practices on an appropriate scale – from individual farm plots and households to entire landscapes and communities
2. Turn new strategic research on soil carbon and nutrient cycles into practical measures that will boost and sustain agricultural productivity
3. Devise new management practices that enhance a soil's ecosystem functions, such as carbon storage
4. Manage soil organisms and monitor their valuable contributions to agro-ecosystem health and human wellbeing
5. Strengthen networks of scientists, development professionals and farmers through training, partnerships and information sharing on soil fertility.

Pest and disease management

A holistic approach to soil fertility means more than just replacing lost nutrients. It also involves dealing with pests and diseases. If Africa's smallholders are to compete successfully, they must be able to grow crops efficiently — without resorting to the overuse of agrochemicals, which are not only expensive but also dangerous to human and environmental health.

CIAT has a long history of successful research to combat pests and diseases in beans. Working with farmers, national agricultural research systems (NARS) and NGOs, CIAT researchers have developed integrated pest management (IPM) strategies against such intransigent problems as bean stem maggot and bean root rot. In Rwanda and Kenya, multidisciplinary teams have overcome major outbreaks of these pests and diseases by improving soil fertility and by developing and disseminating resistant or tolerant crop varieties.

In northern Tanzania, farmer groups and the national bean programme, with support from CIAT, are successfully fighting the destructive bean foliage beetle using an IPM approach that combines local knowledge, notably of bio-pesticides, with new practices such as rotation of bean crops with maize or sunflower. With support from the UK's Department for International Development (DFID), this approach is now being applied to other pest problems in other African countries.

The spread of IPM approaches is facilitated by access to technical information from village information centres (VICs), established and run by local communities. CIAT and partners have helped develop the VIC model, and forty VICs in five countries have so far been set up.

Developing and Accessing Agrobiodiversity

Healthy ecosystems provide a favourable setting in which to introduce improved crops, enabling farm families to target new markets after securing their own food supply. But new crop varieties must also be able to grow reasonably well under less favourable

conditions, including low soil fertility, drought, and pest and disease pressure.

In applying the power of modern plant breeding to African agriculture, CIAT is improving three crops, or groups of crops, that are especially important for poor people living in marginal environments: common bean, cassava, and tropical forages. At the same time, our scientists help national partners acquire new knowledge and skills to boost their work on crop improvement.

In Uganda, for example, CIAT and other CGIAR centres have supported NARO in establishing a molecular biology laboratory, inaugurated by President Museveni in 2003. Students from the region use the lab to carry out their postgraduate research, supported by funding from the Rockefeller Foundation and DFID.

Hi-tech facilities such as these better enable African researchers to investigate useful plant traits and plant pathogens, further enhancing national crop improvement programmes. This work complements the strategy of the New Partnership for Africa's Development (NEPAD), which in 2004 opened the Biosciences for Eastern and Central Africa (BECA) facility at the International Livestock Research Institute (ILRI) in Nairobi. CIAT scientists have already organised training for African colleagues on DNA extraction methods, molecular characterisation of plant pathogens, and the use of molecular markers in crop improvement.

Common bean

Nutritionists refer to the common bean as a nearly perfect food because of its high protein content, generous amounts of fibre, complex carbohydrates, and valuable complements of essential micronutrients such as iron and zinc. New varieties thus offer a powerful means of combating malnutrition. Moreover, as Africa's cities expand, demand for beans is rising rapidly. In much of eastern Africa each person consumes 50–60 kg of beans a year. Beans also have the advantage of a short growing season, and since the crop is grown mainly by women farmers, they reap most of the benefits.

Since the mid-1980s, CIAT scientists have introduced improved bean seeds to the mid-altitude and highland areas of central, eastern, southern and west Africa. This has been done through the national R&D

programmes that make up the Pan-African Bean Research Alliance (PABRA). The alliance includes 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 organisations – ASARECA and the Southern Africa Development Council (SADC). Financial support is provided through a donor consortium that includes the Canadian and Swiss governments.

Through partnerships between national research institutes, universities, farmer associations, private companies and NGOs, the networks are tailoring new varieties to the diverse demands of local food markets, inter-African trade, and more distant export markets. In Africa, bean sales now top US\$580 million a year, half being income to small farmers.

Among the first improved beans to win African farmers' allegiance were climbing types. High yielding and resistant to disease, these space-saving plants are an ideal crop for densely populated, land-scarce areas. And while the success of climbing beans is well established, one of Africa's best-kept secrets is the even greater impact of the new bush-type bean varieties, which farmers have begun adopting rapidly. In six districts of northern Tanzania, for example, 70 percent of farmers report that they now grow the new varieties of CIAT origin released by the Ministry of Agriculture's Selian Agricultural Research Institute - and households that adopted new varieties now not only consume more beans, but have seen their average annual income from beans more than double in the past five years, to the equivalent of US\$590 per household.

To provide African partners with new options for helping the many farmers who face difficult farming conditions, CIAT scientists are developing beans with tolerance to drought and low soil fertility. As part of the CGIAR Harvest Plus challenge programme, they are also identifying bean germplasm with higher iron and zinc content to reduce micronutrient deficiency, which mainly affects women and children, and to boost the immune systems of HIV/AIDS sufferers. If, as bean geneticists expect, the content of iron can be doubled and that of zinc increased by 40 percent, this nearly perfect food will soon be able to do even more to improve human nutrition in Africa and elsewhere.

Cassava

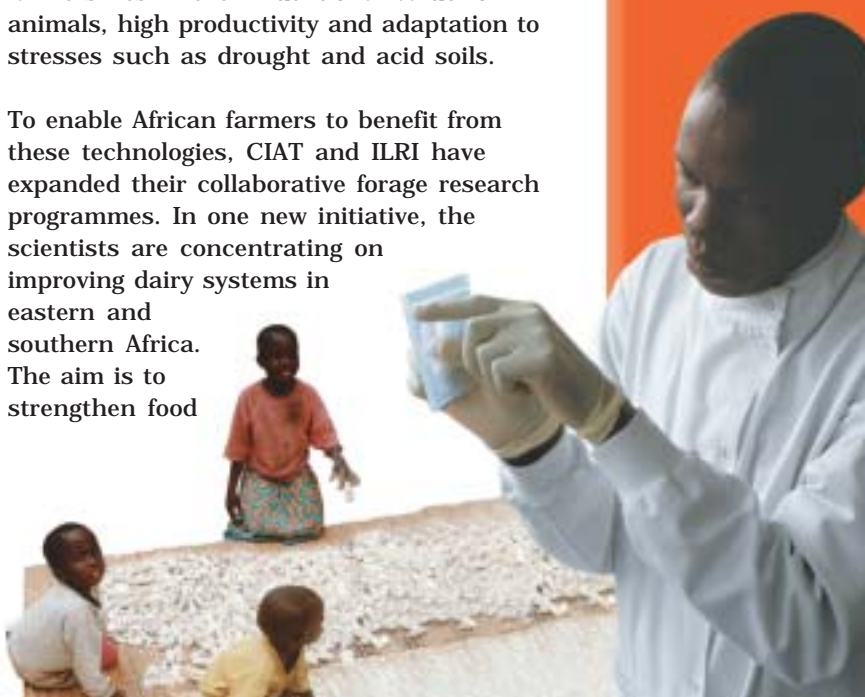
This starchy root crop, native to South America, was introduced to Africa by Portuguese traders several centuries ago. Today, it has become vital for Africa's food security, while also presenting new opportunities to link smallholder farmers to new markets through value-added processing. CIAT's global programme on cassava breeding and germplasm exchange, conducted in collaboration with national partners and IITA, continues to strengthen the crop's development role on the continent.


One of CIAT's key functions in this work is to transfer useful genetic variability and high-value traits – for example, high protein content, good starch quality, and pest and disease resistance – into Africa's cassava gene pool. CIAT does this by providing national programmes and IITA with advanced breeding materials and samples of cassava wild relatives. In addition, CIAT and IITA have jointly developed molecular markers associated with resistance to cassava mosaic disease (CMD), a scourge of the crop in several major cassava-growing countries. With the support of the Rockefeller Foundation, these markers are helping national programmes in Africa to accelerate the development of improved CMD-resistant varieties.

Tropical forages

In Latin America and southeast Asia, improved tropical forage grasses and legumes (some of them derived from materials indigenous to Africa) have proved highly effective for simultaneously intensifying small-scale livestock production and protecting the soil. The appeal of forages to farmers lies in their nutritional value for animals, high productivity and adaptation to stresses such as drought and acid soils.

To enable African farmers to benefit from these technologies, CIAT and ILRI have expanded their collaborative forage research programmes. In one new initiative, the scientists are concentrating on improving dairy systems in eastern and southern Africa. The aim is to strengthen food





security, raise incomes, and improve natural resource management. Initial results from recent on-farm trials by farmers in Ethiopia show that Napier grass, lablab, vetch, pigeon pea, setaria and vetiver are popular species of forage that farmers are interested in growing on their farms. And in eastern Uganda, an improved brachiaria grass bred in Colombia for drought tolerance is proving attractive to farmer research groups for dry-season feed.

Access to technologies

It takes more than the mere existence of new crop varieties to improve the lives of smallholder farmers and their families; these technologies have to be actively disseminated as well. Most private seed companies still tend to focus on a few highly commercial crops with large markets, while in Rwanda, for example, there are no commercial seed suppliers at all.

As local demand for new crop varieties takes off, farmers can take advantage of the new income-earning opportunities they present by forming small seed production businesses. Recent CIAT research has shown that, with adequate support, even small-scale farmers are capable of producing and selling high-quality seed of improved varieties. As part of this, CIAT has developed training materials on the establishment of small-scale seed enterprises. These manuals have proved to be popular training products and, at the request of local development organisations, have been made available to farmers and development workers in eight languages widely spoken in Africa.

National bean research programmes are supporting decentralised seed production and marketing. Seed producers are supplied with seed of improved varieties for assessment and multiplication. They are encouraged to sell their own seeds and to link with local traders.

Community-based seed production, in addition to raising farm income and promoting the adoption of improved varieties, should make agriculture more resilient in the

face of natural disasters. During a drought, for example, farmers will have reliable, local sources of seed to replenish their losses, instead of receiving poorly adapted seed from elsewhere.

However, it is important to note that external perceptions of seed systems can be flawed. In order to provide better diagnoses of the effects of stress – either acute, short-term emergency situations or chronic, long-term poverty-related problems – CIAT with partners such as CRS and support from the United States Agency for International Development (USAID) and International Development Research Centre (IDRC) in Canada have been examining seed systems under stress. New tools for quickly assessing the security of local seed systems in times of acute or chronic stress are now helping donors and relief agencies make faster, better decisions about seed aid and germplasm restoration following acute emergencies. These and other research-based activities will ensure that farmers receive the right help when they need it, without falling into a cycle of dependence on external assistance.

Towards a Healthy, Competitive Africa

We believe that our focus on the three inter-related R&D challenges of enabling rural innovation, managing natural resources and developing agro-biodiversity is the best way for us to contribute towards a healthy, competitive Africa – a vision that the IAC shares. Enabling the poorest and least advantaged to participate fully in creating their own future will have a positive effect on communities, regions, countries, and, eventually, the whole continent. And building capacities of national systems to support farmers and communities in their efforts enhances their chances of success.

CIAT cannot do this work alone. Our partnerships and alliances are powerful ways of gaining local knowledge and specialised expertise while simultaneously addressing the diverse agendas of different stakeholder groups. By working together, researchers, NGOs, extension workers, the private sector, farmer groups and whole communities can make the lasting eradication of hunger and poverty in Africa a reality.



Solutions That Cross Frontiers

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

CIAT is one of 15 food and environmental research centres working towards these goals around the world in partnership with farmers, scientists and policy makers. The centres are funded mainly by the 58 countries, private foundations and international organisations that make up the Consultative Group on International Agricultural Research (CGIAR).

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