

Delivering on the Promise of Tropical Agriculture







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Plenty to Celebrate and Plenty More to Do

CIAT turned 45 in 2012, and we celebrated the anniversary with energy and enthusiasm. It provided us with an opportune occasion for reflecting on the Center's remarkable record of achievement, celebrating the partnerships that made this possible, and undertaking new efforts to deliver on the promise of tropical agriculture.

Grounds for optimism

The early results of impact studies conducted in 2012 suggest that there was plenty to celebrate. One confirmed that in sub-Saharan Africa about 5.3 million rural households – with a total of about 25 million people – have adopted improved bean varieties and production practices, creating benefits that exceed our wildest dreams. That is an extraordinary return on the investment made by various governments (see a list of our donors on page 37) in collaborative bean research.

While providing grounds for optimism, however, such studies can leave no room for complacency. Given the resurgence of food price inflation, the worsening condition of natural resources, and the looming threat of climate change, there is plenty more to do for tropical agriculture.

The important questions for CIAT are what we can do and how to translate donors' investment most effectively into tangible benefits. In response, our

scientists advanced a series of big ideas and initiatives in 2012, which are described in subsequent sections of this annual report. Those efforts will enhance the Center's participation in 12 of the 16 CGIAR Research Programs (see infographic on page 40), which make strategic contributions to a food secure future.

What the world needs now

The biggest of the big ideas we elaborated this year was the concept of eco-efficient agriculture. As part of CIAT's 45th anniversary celebrations, involving events in Latin America and other regions (see box), we published a scientific book titled *Eco-efficiency: From Vision to Reality*.¹

Featuring a foreword by Ken Cassman, who chairs CGIAR's Independent Science and Partnership Council (ISPC), the book describes advances and new options in the improvement of crops and agricultural systems, which will enable agriculture to compete more effectively in markets while also becoming sustainable and resilient. That is what the tropical world needs if it is to meet growing demand for food and boost rural incomes while reducing agriculture's environmental footprint.

¹ Available at: <http://ciat.cgiar.org/new-publications/>. See also our brochure summarizing the book's key messages at: http://ciat.cgiar.org/wp-content/uploads/2012/12/eco_efficiency_from_vision_to_reality11.pdf



Ken Cassman, Chair, CGIAR Independent Science and Partnership Council.

To launch our new book, we held Eco-Efficiency Day in early July at Center headquarters in Colombia. It included a panel discussion about the book's key messages; a lively debate on eco-efficiency in relation to other green paradigms; and a workshop titled "Eco-Efficiency Starts at Home," which examined measures to reduce the Center's carbon footprint and in other ways make its facilities and operations more eco-efficient.

Envisioning a new future

The eco-efficiency concept has begun to resonate in CIAT's host country, Colombia, which is making a

Message from the Board Chair and Director General

Shared success in sub-Saharan Africa and Southeast Asia

CIAT has contributed vitally to agricultural development in Africa and Asia. It was thus fitting for our staff in those regions to round out the Center's 45th anniversary celebrations through events that brought together a total of about 200 representatives from donor agencies, agricultural ministries, regional and national partner organizations, and the private sector.

Featuring keynote presentations and panel discussions, an event held in early October at Nairobi, Kenya, explored the way forward for Africa's smallholder agriculture. The discussions emphasized the importance of increased public investment in research as well as the critical role of public-private partnerships for unlocking the huge potential of Africa's agriculture.

In Southeast Asia, research on cassava and tropical forages has done much to increase the competitive strength of upland agriculture, yielding substantial benefits for smallholder farm families. During an event held in early September at Hanoi, Vietnam, we explored with high-level stakeholders future directions for our collaborative research in the region.

major push to sharpen the competitive edge of high-priority regions and agricultural value chains against the background of new international free-trade agreements. Eco-efficient agriculture is vital if the country is to achieve its rural development goals while also exercising wise stewardship of its extraordinary endowment of biodiversity and other natural riches.

That was the central message of a 45th anniversary forum on eco-efficient agriculture in Colombia, which took place at our headquarters just after Eco-Efficiency Day. The centerpiece of the event

consisted of panel discussions, in which two agriculture ministers – Juan Camilo Restrepo of Colombia and Gloria Abraham of Costa Rica – together with other distinguished experts brought national and international perspectives to the task of envisioning a new future for Colombia's agriculture.

Read on!

Having clearly defined the eco-efficiency vision, our challenge now is to make it a reality in all of the regions where CIAT works. Toward that end, Center scientists advanced on many fronts this year, as

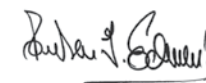
indicated in the following theme essay and science stories, which form the core of this annual report, covering the period from early 2012 to early 2013.

Among the highlights of that period were the important progress of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), of which CIAT is Lead Center; a major revision of our strategies for global soils research and for incorporating superior tropical forages into smallholder crop–livestock systems in Africa; and the creation of a stronger framework in Central America for confronting the region's agricultural challenges through integrated research involving various CGIAR Research Programs and national partners.

Read on! If you like what you see, consider supporting and working with CIAT, where well-managed research investments help people overcome hunger and poverty while reducing agriculture's environmental footprint across the tropics.



Wanda Collins
Chair, Board of Trustees



Ruben G. Echeverria
Director General

Forward to 50!

Tropical agriculture is an intricate global mosaic, encompassing environments as different from one another as South America's grassland savannas and the intensively farmed highlands of sub-Saharan Africa and uplands of Southeast Asia. What can the world expect from research on such a vast and varied enterprise?

For CIAT's founders – representing the government of our host country, Colombia, together with the Rockefeller, Ford, and Kellogg Foundations – the answer was clear. They believed that high-quality science, focused on diverse crops and cropping systems, can help deliver on the promise of tropical agriculture through increased farm productivity, leading to reduced hunger and poverty.

Nearly a half century later, we can say with confidence that our founders were correct. Since its creation in 1967, CIAT, working with hundreds of partners, has amassed a remarkable record of science for change. In addition to validating the original concept on which the Center was based, CIAT's work has contributed to the wider efforts of CGIAR to advance the sustainable development agenda, which took shape at the 1992 Earth Summit held in Rio de Janeiro and was reaffirmed by world leaders at the 2012 Rio+20 event.

Proof of the promise

The question now is how CIAT, along with other CGIAR centers and partners, can continue to deliver on the promise of tropical agriculture, despite converging crises in the global climate, environment, and economy. In response, CIAT researchers are devising new strategies and collaborative arrangements that measure up to the challenges and opportunities before us.

Particularly from now until the time CIAT turns 50, those efforts will be channeled in four main directions:

1. **Crafting the crops of the future** – new generations of more productive and resilient varieties that farmers need and want
2. **Value chain reactions**, which enable large numbers of farmers to compete in markets
3. **Results *in the ground***, leading to large-scale improvement in soils and rural landscapes
4. **Climate change exposés** to help national organizations and rural communities address climate change

Strong donor support for this work is fundamental for our success in delivering new proof of tropical agriculture's promise.

Quick wins in climate change research

The future impact of CIAT science will depend to a large degree on our strategic contribution to the shared endeavors of a new CGIAR.

We are especially proud to serve as Lead Center of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). In the 2 years since CCAFS began, it has set the bar high for other CGIAR programs just now getting underway. In addition to serving as a model of sound governance, CCAFS has shown a knack for achieving quick wins through the use of innovative tools and collaborative ways of working. In early 2012, for example, the program embarked on a pioneering effort to foster creative thinking about climate change adaptation among representatives of government, civil society, and the private sector in East Africa. (For more information on CCAFS achievements, see page 8).

CIAT's Decision and Policy Analysis (DAPA) Research Area provides leadership and strategic scientific input for the CCAFS research theme "Adaptation to Progressive Climate Change." That work will benefit greatly from DAPA's newly acquired gender leadership and research capacity. DAPA has also devised a comprehensive approach for monitoring and evaluation, which will make all of CIAT's research more effective and accountable.

Soils research renaissance

CIAT is aligning its work with other CGIAR Research Programs as well (see infographic on page 40). More than a matter of relabeling or rearranging current activities, this involves a significant revision of the Center's research strategies and capacities.

One especially valuable outcome of that effort is a new CIAT strategy for global soils research (see box on page 23). Cutting across tropical crops and

agro-ecosystems, this work is fundamental for reducing hunger and poverty, halting land degradation, and making agriculture climate smart. CGIAR must urgently renovate its soils research capability, and CIAT is uniquely qualified to contribute.

Building on research carried out by the Center's Tropical Soil Biology and Fertility (TSBF) Institute in Africa and its soils team in Latin America, the new strategy aims for large-scale impact by using advanced tools and knowledge to reduce key constraints of major production systems and to enhance ecosystem services that support agriculture (see stories on pages 20, 22, and 26). The strategy comes at a time when major donors, notably the German government, are addressing forcefully the issue of degraded soils and landscapes.



Delivering on the Promise of Tropical Agriculture

Fast track to impact

CIAT's Agrobiodiversity Research Area is also making important adjustments aimed at widening development impact through CGIAR Research Programs and other channels.

Our tropical forage scientists in Eastern and Central Africa, for example, have taken up a fast-track research strategy to integrate more productive grasses into mixed crop–livestock systems. Accounting for most of the region's meat and milk supplies, those systems also provide livelihoods for some 50 million people (see box on page 19).

CIAT crop scientists have launched a series of workshops to revise the vision and strategies of our research on agricultural biodiversity in light of important scientific breakthroughs. The idea is to accelerate improvement in crop productivity, resource-use efficiency, and resilience under stress by combining well-established methods like hybrid rice

Livestock producer at Pemba Island, Tanzania.

development (see page 12) with cutting-edge science, as illustrated by the global effort to decode cassava's genetic makeup (see page 10).

Between the New World and the whole world

CIAT's strong efforts in Africa and Asia have a dynamic of their own, which responds to the needs of millions of smallholder farmers laboring under difficult conditions. Our work in those regions also draws on research in Latin America and the Caribbean (LAC), which recognizes the enormous development possibilities of this region, while also ensuring that its impressive capacity for agricultural innovation benefits the whole world.

Several recent advances in our work for LAC mean good news globally. As described on page 26, for example, CIAT's strategic alliance with Colombia's government is delivering new knowledge and technology that will help fulfill the country's ambition to make its Orinoquia region into an agricultural commodity powerhouse as well as a showcase of eco-efficiency.

Meanwhile, a new Colombian science park (Biopacific Park), whose creation in late 2011 received CIAT support through a development-oriented entity called FUNDACIAT, is designing strategies for research, innovation, and training (see page 28). Part of an ongoing global experiment with institutional models that nurture entrepreneurial spirit, Biopacific Park is preparing to become a significant agribusiness incubator focused on tropical fruits and other crops grown in Colombia's hillside areas.

With the aim of helping reinforce Colombia's food security and competitive strength in agriculture, CIAT has entered into another strategic alliance with the government that focuses mainly on climate change adaptation (see box).

CIAT scientists and management also worked closely with agriculture ministers from Central America to create a stronger framework for collaborative research. This is already facilitating the coordination of work to be undertaken by several CGIAR Research Programs in a region of deeply entrenched rural poverty and degraded landscapes but also great potential for sustainable growth.

Re-routing the future

In Latin America and elsewhere, tropical agriculture faces growing uncertainty created by food price volatility, climate change, and other trends that are hard to predict. As a result, making reliable decisions about research, policy, and investment will become increasingly important.

With the aim of fostering well-founded decisions that reinforce renewed efforts to achieve food security in LAC and beyond, CIAT has joined forces with the Inter-American Development Bank and others in a series of foresight studies on agriculture (see box on page 30). Initial results were presented at the 2012 Global Conference on Agricultural Research for Development (GCARD), where foresight was a central theme.

The studies suggest that LAC will most likely retain its new status as a global food basket, helping

stabilize prices through world trade. They also underline the region's strategic importance as a major provider of global environmental goods, like biodiversity. In addition, the studies indicate how LAC can play this important dual role even better by intensifying agricultural research and development, with benefits for this region and the entire world.

New foresight studies along with other shifts in the Center's research strategies form part of our effort to re-route agricultural development toward an eco-efficient future. If the Center's founders were to visit CIAT today, we trust they would find plenty of evidence to sustain their belief in the promise of tropical agriculture and in the wisdom of the experiment that led to the Center's creation.

Rice trials near Villavicencio, the gateway to Colombia's Eastern Plains.

Coming to terms with climate change in Colombia

In a nation as geographically diverse as Colombia, climate change is bound to have highly complex implications for agriculture, posing multiple threats as well as opportunities. Hence the government's decision to assign the farming sector high priority in its adaptation and mitigation strategies.

In support of that effort, CIAT will work with government organizations, farmer associations, and others in three key tasks:

1. Coping with immediate climate risks through improved seasonal agro-climatic forecasts, fine-tuning of crop and resource management, and wider use of resilient crop varieties.
2. Fostering agricultural transformation over the longer term by using simulation models to project future conditions and guide the development and spread of improved technologies.
3. Realizing agriculture's climate change mitigation potential through schemes that involve payment for ecosystem services (PES), which offer rural communities financial incentives to invest in low-carbon production systems.

The effort will concentrate on staple foods as well as commercial crops with strong export potential. It will cater especially to regions where farmers have limited resources for coming to terms with climate change.

Creating Quick Wins

In its second full year of operations, CCAFS delivered a diverse array of important results, which provide grounds for hope that smallholder farmers, with the aid of advanced science, can come to terms with climate change. Following are some highlights.

Commission on Sustainable Agriculture and Climate Change

Comprising eminent scientists from 13 countries, the Commission prepared a final report that outlines seven key actions needed to safeguard the global food system in a changing climate. Released in March 2012, the report received international attention, including feature coverage by the BBC and an endorsement by *The New York Times*. An animated film accompanying the report has been viewed more than 17,000 times on YouTube. The Commission followed up on its report with a journal article describing the important role scientists perform in addressing food security and climate change. <http://ccafs.cgiar.org/commission/reports>

Twin calls for global action

The Fourth Agriculture and Rural Development Day (ARDD), held in June 2012 at Rio de Janeiro, Brazil, alongside the United Nations Conference



Kalpana Venkatasubramanian addresses the CCAFS side event at the United Nations Climate Change Conference in Doha, Qatar.

on Sustainable Development (Rio+20), called for a “new vision of sustainable development,” which recognizes agriculture’s contribution to economic growth, food security, poverty reduction, and environmental sustainability. Attracting more than 600 experts, the event focused on sharing practical, effective innovations that can strengthen food systems. The final Rio+20 conference text prominently mentions food security, sustainable agriculture, and small-scale farming. <http://ccafs.cgiar.org/blog/small-wins-small-farmers-rio20>

Agriculture, Landscapes and Livelihoods Day (ALL-5 Day), held in parallel with the United Nations Climate Change Conference in Doha, Qatar, underlined the need for action to curb the impacts of climate change on food security, the environment, and rural livelihoods. Agriculture has so far been neglected in international climate change negotiations, and a work program for agriculture has yet to materialize. At the

Doha meetings, negotiators postponed discussions about agriculture until the next round of talks in June 2013. Some participants in ALL-5 Day conveyed their frustration with this decision in strong statements to international media. <http://ccafs.cgiar.org/blog/report-back-agriculture-landscapes-and-livelihoods-day>

Climate change adaptation in East Africa

Research results published in the journal *Food Security* during 2012 show that, while many smallholder farmers in East Africa have adopted climate-resilient farming practices, such as agroforestry and intercropping, a more far-reaching transformation of agriculture has not yet begun. The results come from an extensive 2011 survey coordinated by CCAFS at sites across the region, with the aim of determining how farmers already deal with climate variability and what factors could prompt them to make further changes in response to future climate change. <http://ccafs.cgiar.org/blog/bit-bit-east-african-smallholder-farmers-adapting-climate-change> (infographic) and <http://dx.doi.org/10.1007/s12571-012-0194-z> (journal article).

CCAFS extends its regional reach

CCAFS is expanding its work to include two more regions. A new program for Latin America is being

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

coordinated by Ana María Loboguerrero from CIAT headquarters in Colombia, while a program for Southeast Asia will be hosted by the International Rice Research Institute (IRRI) from Hanoi, Vietnam.

Climate information services for farmers

Information can be a powerful means to help farmers deal with a variable climate. In search of better means to realize this potential, CCAFS is supporting evaluations of national agrometeorological advisory services in Mali and India, which are both reaching farmers successfully. The Program fostered learning within and across regions by holding a workshop in December 2012, which brought together partners from sub-Saharan Africa and South Asia to share good practices and discuss constraints. <http://ccafs.cgiar.org/blog/Equity-capacity-%20uilding-key-scaling-up-climate-services>

Recalibrating the global food system

CCAFS produced two documents in 2012 that shed light on the challenges posed by climate change for the global food system. Together, the studies generated significant coverage in major media, including BBC Television World News, Agencia EFE (Spain), Deutsche Presse-Agentur (Germany), Reuters AlertNet, and NatureNews.

One of the documents was a policy brief that summarizes climate change impacts on key crops and natural resources. Based on input from more than 70 scientists at 14 CGIAR centers, the brief suggests that global crop production will have to be recalibrated as climate change causes significant shifts in weather patterns, water use, and the dynamics of crop pests and diseases. The other was a review of estimated greenhouse gas emissions across the entire global food supply chain. <http://cgspace.cgiar.org/handle/10568/24696> and <http://dx.doi.org/10.1146/annurev-environ-020411-130608>

Big facts

A CCAFS product referred to as Big Facts presents 30 key messages based on results from the latest and most authoritative research dealing with topics that range from human nutrition to climate change mitigation in agriculture. Featuring infographics and compelling photographs from the field, the Big Facts are accompanied by a subset of supporting facts and



a list of references for sources of more detailed information. <http://ccafs.cgiar.org/bigfacts>

Focused on gender

CCAFS and the Food and Agriculture Organization of the United Nations (FAO) highlighted women's crucial contribution to food security and their acute vulnerability to climate change impacts in a new gender research training guide designed for professionals engaged in participatory action research. The Program has also developed working papers, blog stories, and other materials on gender, which are receiving considerable attention. <http://ccafs.cgiar.org/gender>

Smallholders and climate change mitigation

In a new policy brief, CCAFS researchers describe how governments and others can provide large numbers of farmers with stronger incentives and support to transition toward agricultural practices that reduce greenhouse gas emissions. According to CCAFS analysis, the sale of carbon credits may not generate enough revenue to prompt most farmers to change their practices. <http://ccafs.cgiar.org/blog/supporting-smallholder-farmers-mitigate-how-do-we-move-forward>

Crafting the Crops of the Future

Efforts intensify to decode cassava “alphabet soup”

Imagine having to write a story, using a pile of several billion letters. First the letters have to be arranged into words, the words into sentences and paragraphs to produce a coherent, accurate chapter. There are 18,000 chapters in each book, and 5,000 books make the full story. The story is the complete genetic history of cassava.

From first draft to full story

Making biological sense of that pile of letters – otherwise known as sequencing the cassava genome – might seem like a daunting prospect, but the result should be a precise genetic fingerprint of the plant and all its known variations. It promises to accelerate the development of improved varieties by helping scientists home in on the genes responsible for increasing yields, boosting

starch or protein content, and improving resistance to notorious pests like whitefly and diseases like brown streak.

“Genome sequencing generates an enormous amount of data – at the moment we just have an ‘alphabet soup’ of information that we need to arrange into the right order,” explained CIAT cassava geneticist Luis Augusto Becerra. “But once all those letters are in order, it means we will really, truly understand cassava.”

The first draft of the cassava genome was completed in 2009 by the U.S. Department of Energy Joint Genome Initiative (DOE JGI) and 454 Life Sciences. While it only sequenced one cassava variety – the equivalent of one single book in the set – this was enough to help scientists isolate the gene responsible for “waxy” or amylose-free starch, a major breakthrough for the development of high-value

cassava for industrial use. Crucially, the first draft also provides a firm foundation for speeding up subsequent sequencing, since all cassava varieties contain similar characteristics to the draft, with only small variations in the sequence responsible for particular characteristics. In just 3 years, the first draft has enabled a further 200 varieties to be quickly decoded.

Using cassava varieties conserved in genebanks around the world – including domesticated “landraces” and undomesticated wild relatives – a further 1,000 varieties will be sequenced in 2013, with funding from the CGIAR Research Program on Roots, Tubers and Bananas. The aim is for all 5,000 cassava varieties – representing an estimated 95% of the crop’s global genetic diversity – to be sequenced by 2017.



CIAT scientists analyze cassava gene sequences.

Breeding cassava by computer

Launched in mid-2012, the Global Cassava Genome Initiative, jointly coordinated by CIAT and the Beijing Genomics Institute (BGI), with support from the International Institute of Tropical Agriculture (IITA), Japanese firm RIKEN, DOE JGI, and the Chinese Academy of Tropical Agricultural Sciences (CATAS), will pool the expertise of scientists and the technical capacity of participating institutions around the world to try and speed up the process of putting the pieces of the puzzle together.

“This initiative will really help to accelerate the work to decode cassava,” continued Becerra. “So, it’s not a matter of *if* we’re going to find, say, the genes responsible for resistance to whitefly, or increasing yields – it’s a matter of *when*.”

Once the cassava genome is fully decoded, scientists will be able to support cassava breeding *in silico* (on the computer) to establish the most effective combinations of parent plants to produce offspring with the desired traits. This will help cassava fulfill its enormous potential as a climate-resilient source of food and industrial raw material (see box) – in a fraction of the time required by conventional breeding methods.

A farmer in northern Tanzania checks her cassava crop.



“Rambo root” could beat climate change in sub-Saharan Africa

Cassava could be the best bet for farmers in sub-Saharan Africa to beat climate change, according to a landmark CIAT study.

The research, published in a special edition of the scientific journal *Tropical Plant Biology* in 2012, found that the rugged root crop will brush off expected temperature rises of up to 2 degrees Celsius in the region by 2030 – and could be *even more* productive under climate change.

Originally from South America, cassava is now one of the most important sources of carbohydrate in sub-Saharan Africa, where it is consumed by around 500 million people every day. Its ability to produce starch-rich roots in poor soils and with little water makes it a reliable crop in difficult environments. Scientists compared the expected impacts of climate change on the production of cassava and six other key staple crops in sub-Saharan Africa – potato, maize, bean, banana, millet, and sorghum.

They found that by 2030 temperature rises of between 1.2 and 2 degrees Celsius, combined with changes in rainfall, will leave cassava in a class of its own. In East Africa, for example, it bucks the trend of declining suitability of all other crops in the study, with a 10% increase. In West Africa, cassava will hold its ground, significantly exceeding the suitability of potato (-15%), bean (-20%), and banana (-13%).

“This really proves that cassava is a survivor; it’s the Rambo of the food crops,” said CIAT climate scientist and the report’s lead author, Andy Jarvis. “It thrives in high temperatures, and if drought hits it simply shuts down until the rains come again. There’s no other staple crop with this kind of resilience. The ideal situation, of course, is for farmers to plant a range of crops, with cassava acting as a failsafe.”

According to the report, more research is needed to reduce cassava’s vulnerability to pests and diseases.

“Tackling these threats could be the final hurdle to a food secure future for millions of people,” continued Jarvis. “Cassava could be one of the most climate change-resilient crops an African farmer can plant; it could even enjoy climate change.”

Hybrid rice for Latin America

A new public-private partnership across Latin America promises to boost rice productivity and could help bolster the region as an emerging food basket for the world.

Launched in 2012, the Hybrid Rice Consortium for Latin America (HIAAL, by its Spanish acronym) brings CIAT researchers together with other rice scientists, traders, millers, and farmer organizations in 13 countries to develop high-yielding rice hybrids specifically adapted to the region. The move reflects the high importance given to hybrid rice by the CGIAR Research Program on Rice, also known as the Global Rice Science Partnership (GRiSP), whose research aims to help meet the ever-growing world demand for rice.

Hybrid rice involves crossing two distinct inbred rice lines to obtain genetically superior offspring that are up to 20% more productive. While well-established in Asia – over half of China’s rice comes from hybrids – and to a lesser extent in Africa, hybrid rice accounts for less than 2% of Latin America’s rice area.

More vigorous rice

Rice is self-pollinating, containing both male and female parts that produce offspring genetically identical to the parent plant. While this ensures the passage of particular characteristics from one generation to the next, it limits the options for crop improvement. To produce superior, hybrid rice that combines the beneficial traits of distinct rice varieties and takes advantage of “heterosis” – the tendency of

crossbred varieties to outperform the parent plants – scientists first have to develop rice varieties with male sterility so that cross-pollination can occur.

As well as higher yields, the hybrid rice varieties developed by the Consortium will combine multiple additional traits that target some of the most critical constraints in the region. These include resistance to diseases, such as rice blast and rice *hoja blanca* virus, and the need for high grain quality – essential for rice traders and processors.

The varieties will also be developed to be better suited to the practice of direct seeding – the machine planting of rice seed straight into the ground, rather than the manual transplanting of seedlings common in Asia and Africa. Direct-seeded rice needs to have deep roots to avoid lodging – the windblown toppling of plants – and strong stems to bear the weight of heavy panicles. HIAAL’s hybrid rice research could combine all of these traits into single “super varieties.”

Building on the best

In the newly established Consortium, CIAT will make the initial test crosses based on rice varieties in its own collection, those of the International Rice Research Institute (IRRI) in the Philippines, and the top-performing commercial rice varieties and experimental “elite lines” developed by participating institutions in Latin America. After initial testing, CIAT will distribute the hybrids to Consortium partners for subsequent testing and further improvement.

A system of royalties has been established to reward participating institutions when their rice varieties are used as parents of the new hybrid plants. The payments help ensure that participating institutions provide the breeding program with their best varieties and partners receive a steady stream of funds for continued investment in the initiative.

“It’s high-risk, expensive research, but the benefits are potentially huge,” said Edgar Torres, leader of CIAT’s Rice Program. “But by forming a public-private partnership of this kind, we have two main advantages: access to the best germplasm – a lot of which is well adapted to the region – plus a strong, extensive testing network to test the varieties in different regions and environmental conditions. This is extremely expensive for private companies to do.”

One potential issue is that the benefits of the hybrid varieties only last one generation, before yields begin to drop and variability in the traits begins to creep in.

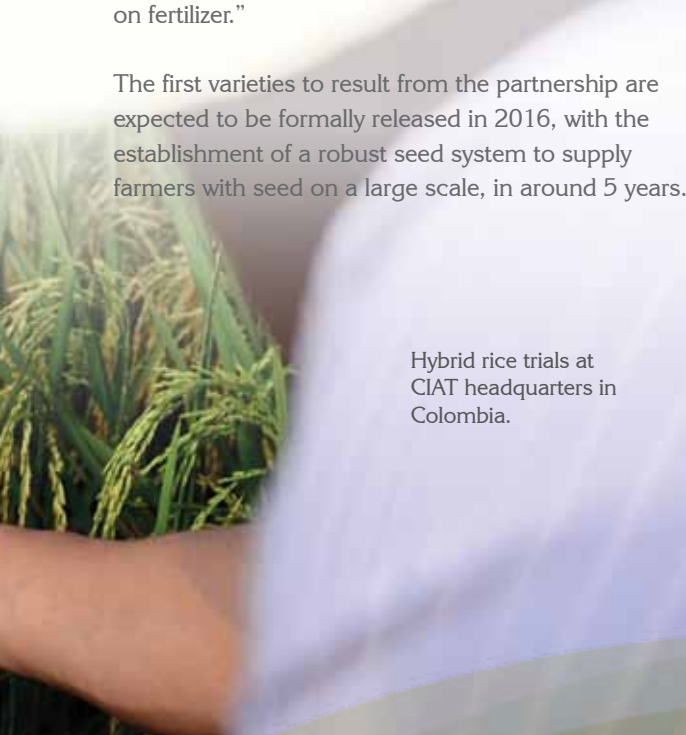


For this reason, farmers will need to buy hybrid seed each year, instead of keeping a portion of their harvested seed for planting. For Torres, this is actually one of the advantages of hybrid rice in the region:

“It means that farmers will have high-quality, certified seed each season, which will help to ensure consistently high yields and limit the spread of diseases and problems such as red rice. It will also mean that a seed market can be established, enabling us to reach many more farmers.

“With the deeper roots associated with lodging tolerance, we expect the hybrids to be able to access nutrients deeper in the soil, so the cost of buying the seeds will be partially offset by reduced expenditure on fertilizer.”

The first varieties to result from the partnership are expected to be formally released in 2016, with the establishment of a robust seed system to supply farmers with seed on a large scale, in around 5 years.



Hybrid rice trials at CIAT headquarters in Colombia.

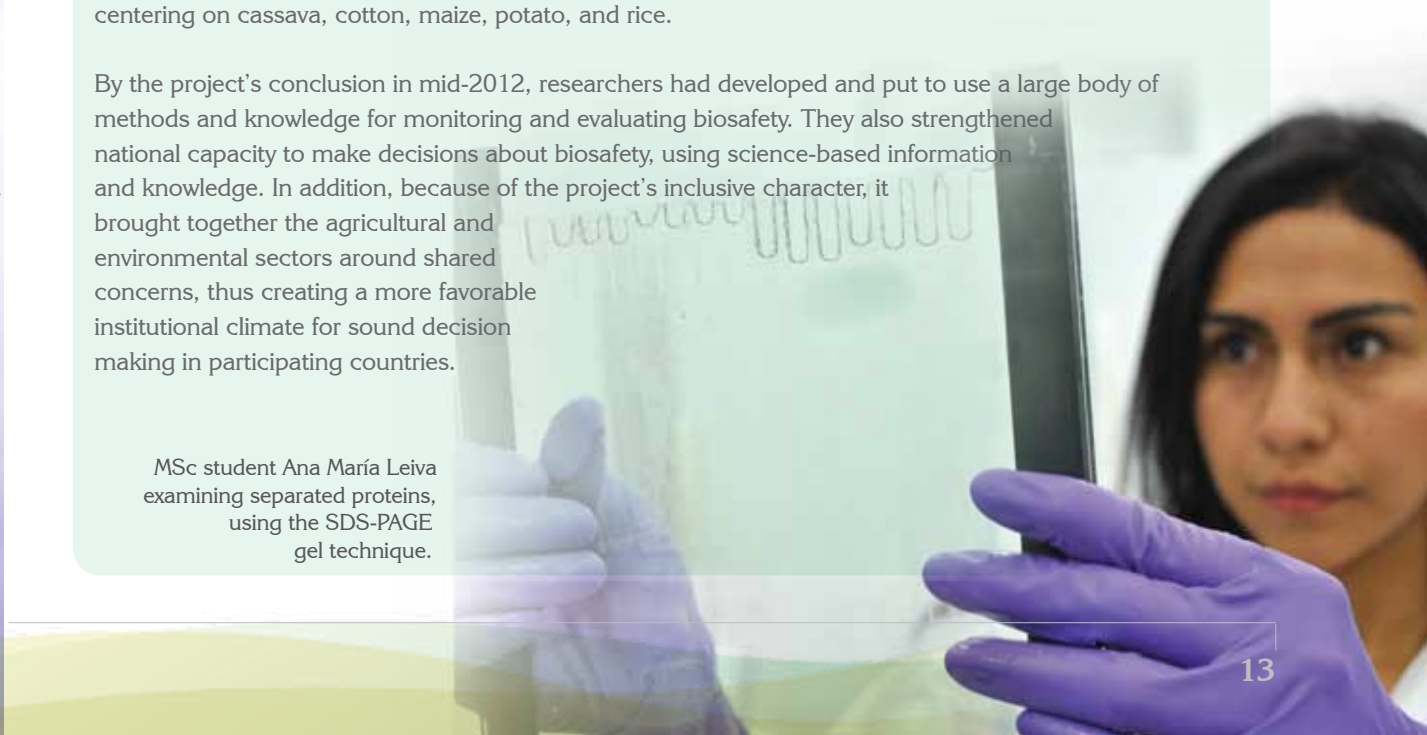
Regional action to strengthen biosafety

Rising global demand for food, feed, fiber, and biofuel is putting huge pressure on tropical agriculture to improve its performance. One likely consequence is accelerated development and adoption of genetically modified (GM) crops. In 2012, such crops were sown to an estimated 60 million hectares in 10 countries of Latin America and the Caribbean (LAC), contributing to a record 170 million hectares globally and helping make GM varieties the most rapidly adopted crop technology in recent times, despite the lack of appropriate regulatory systems in some countries.

To protect biodiversity from the potential risks involved in transferring and using GM crops, it's urgent that countries here and in other regions implement the Cartagena Protocol, which was created in 2003 precisely for this purpose. Most countries in LAC – which is exceedingly rich in biodiversity – have ratified the agreement. Yet, few have all the scientific capabilities needed to convert the Cartagena vision into a reality.

As part of a global effort to remedy this shortcoming, the LAC-Biosafety project was begun in 2008 with support from the Global Environmental Facility (GEF) through the World Bank. Coordinated by CIAT, LAC-Biosafety brought together 66 institutions in Brazil, Colombia, Costa Rica, and Peru for joint efforts centering on cassava, cotton, maize, potato, and rice.

By the project's conclusion in mid-2012, researchers had developed and put to use a large body of methods and knowledge for monitoring and evaluating biosafety. They also strengthened national capacity to make decisions about biosafety, using science-based information and knowledge. In addition, because of the project's inclusive character, it brought together the agricultural and environmental sectors around shared concerns, thus creating a more favorable institutional climate for sound decision making in participating countries.



MSc student Ana María Leiva examining separated proteins, using the SDS-PAGE gel technique.

Better crops, better nutrition

HarvestPlus, the joint CIAT–International Food Policy Research Institute (IFPRI) program to develop nutritionally improved – or “biofortified” – staple food crops in Africa, Asia, and Latin America, marked its ninth year with a number of new crop releases and improved systems to get the crops into the hands of smallholder farmers.

Ahead of the curve

Achieving a year ahead of schedule its target to reach 100,000 new households with new varieties, HarvestPlus now expects 500,000 households will benefit from its portfolio of improved rice, wheat, cassava, sweet potato, maize, bean, and pearl millet by the end of its current phase in 2013.

In Rwanda – where four nutritionally improved bean varieties have already been released, five new kinds of iron-rich climbing beans were released in 2012, targeting over 130,000 households. The beans provide up to 30% of the daily recommended iron requirements of women and children, and the work complements government efforts to tackle iron deficiency, which affects around 40% of children and a large number of women in the country.

HarvestPlus now aims to reach an additional 150,000 households in Rwanda with the improved climbing beans and a further 75,000 in the Democratic Republic of the Congo with improved climbing beans and bush beans. The iron-rich beans, which have already been released in neighboring Uganda, are currently being tested for their suitability in Zambia, Zimbabwe, Tanzania, and Burundi.

Other releases in 2012 included new varieties of vitamin A-rich maize in Zambia and Nigeria, and high-iron pearl millet in India. In Latin America, new bean varieties with higher levels of iron were released in Nicaragua. The release schedule for 2013 includes the launch of high-zinc wheat in India and high-zinc rice in Bangladesh.

Fine-tuning the system

Reaching the target for disseminating new varieties a year ahead of time was partly achieved by fine-tuning channels of seed distribution and testing new ones. One novel way of distributing the new vitamin A-rich cassava crops in Nigeria, for example, involved the commitment of farmers receiving the new varieties to pass stem cuttings to at least two of their neighbors.

While dissemination of improved beans in Africa continues to focus on the use of small, popular, and affordable seed packs for farmers – around half-a-million packs have been sold in Rwanda alone in the last 2 years – HarvestPlus has also been trialing a new “payback system.” Under the system, which specifically targets some of Rwanda’s poorest



producers, around 130 tonnes of high-iron beans were sold to local agricultural offices and distributed free of charge to cash-strapped farmers, who then grew the beans under the supervision of extension workers and the HarvestPlus team. After harvest, the farmers paid back their initial quota in the form of grain, while consuming or selling any surplus. This initiative helped get nutritionally improved beans into the hands of an additional 20,000 farmers very quickly.

Under a new arrangement also established in 2012, some of the grain received by HarvestPlus through

the payback system will now be sold to the UN's World Food Programme, as part of its Purchase for Progress initiative, which seeks to source seed from smallholder farmers in developing countries for use in its emergency relief programs. HarvestPlus will plow the proceeds from this arrangement back into seed multiplication for smallholders.

Following the CGIAR reform process, HarvestPlus is now a major partner in the Research Program on Agriculture for Nutrition and Health (A4NH),

officially launched in 2012. The program brings together researchers across the agriculture, nutrition, and health spectrum to jointly develop solutions to key challenges in the developing world.

HarvestPlus is funded by more than a dozen donors (see list of CIAT donors on page 37).

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Value Chain Reactions

Four-legged futures – Turning Vietnam’s cash cows into cash flow



Ngo Van Hung, 39, is poised to quit his job as a builder in Vietnam’s Ea Kar District. Around 6 years ago, he started getting a lot of work in the village of Chu Cuc, a community of smallholder farmers. He’d built a new home here, another one there – all of them big stone houses replacing the smaller wooden ones.

By the time he’d built his 20th new home in the village, he knew the farmers’ secret: they had implemented a livestock system that was earning them thousands of dollars. Now he wants to do the same.

Until recently, livestock husbandry in this part of Vietnam’s Central Highlands was not very productive. Animals were intermittently sold to free up cash for weddings or large purchases, and the rest of the time they were left free to graze on native pasture and crop residues.

In 2000, CIAT researchers, in partnership with Vietnam’s Tay Nguyen University (TNU) and with funding from the Asian Development Bank (ADB), looked for ways to revitalize the region’s livestock sector. They assessed farmers’ needs, tested different kinds of improved forages selected in Southeast Asia in earlier work, and most importantly, developed improved management strategies with farmers.

The partnership continued to grow through a subsequent project funded by the International Fund for Agricultural Development (IFAD), resulting in the development and adoption of a new livestock system, like the one in Chu Cuc.

Cut and carry

The system hinges on confining cattle to lots and providing them with high-quality feed. Extension workers recommend that farmers plant part of the cropland with nutritious forages suited to the area, such as varieties of elephant and Napier grass, *Brachiaria*, and *Stylosanthes*. Farmers are also encouraged to invest in more productive crossbreeds that respond better to improved nutrition.

The forages are cut and carried to the lots twice a day as part of an intensive fattening program that lasts around 6 months per animal. Clubs formed around groups of cattle-fattening farmers then help members to get in touch with traders and stay informed about developments in the cattle market.

While Chu Cuc used to be coffee land – part of the government’s drive to become a major Robusta exporter – the soils there are poor, and coffee prices were often unpredictable.

“Sometimes it would cost us more to produce and pick the coffee than what we would get for it at market,” said farmer Wang Van Ting, who switched to the new livestock system in 2006.

One of the farmers in the village with a new house, Ting said he earns so much from his cattle that the government no longer classifies him as poor. The legacy of coffee lives on, though, and an irrigation reservoir built for Chu Cuc’s coffee plantations now serves for dry-season forage cultivation.

Ting’s neighbor went one step further. In 3 years, he’s earned enough money from fattening his nine cattle – and by trading his own and others’ – to pay the US\$25,000 to construct his nearly completed new home. This is also where we meet his builder, Ngo Van Hung, who has seen the impacts of the livestock system unfold in front of him.

Further up the road we met Nguyn Hui Nhon, one of Chu Cuc’s pioneer farmers, also with a modern new home. She told us her eldest son is studying advertising at university in Ho Chi Minh City; her second-oldest is a photographer. She beams as she returns to her plot to cut some more king grass.

These are impressive stories from a village where each household only has around a hectare of land.

Ripple effects

According to Truong Tan Khanh, vice dean of the Faculty of Animal Science and Animal Health at TNUI, over 500 farmers are now using the intensive cattle fattening system in Ea Kar, with those in Chu Cuc

hosting exchanges of interested farmers from further afield. Despite its success so far, Khanh says the new project needs to expand to involve more marginalized farmers from some of the country’s many ethnic minority groups.

With the lessons from places like Chu Cuc, the new CIAT-led Cambodia, Laos, and Vietnam Livestock Project (CLVLP) – also funded by IFAD, and officially launched in 2012 – is now working to promote the adaptation and adoption of improved livestock production systems in neighboring provinces across the area known as the Cambodia-Lao-Vietnam Development Triangle.

“The aim is to transform livestock from a cash reserve into a productive asset, drawing on the successes in places like Chu Cuc,” explained CIAT’s Adrian Bolliger, the CLVLP coordinator. “We don’t want to introduce livestock where animals haven’t been kept before but rather improve systems where farmers already have animals.”

As well as extending suitable forage and livestock husbandry practices, the 4-year project takes a broader, value-chain approach to ensure that smallholder livestock production results in better returns at market.

Back in Chu Cuc, builder Ngo Van Hung said that switching careers to livestock production will mean he can work half the hours for double the money, while being his own boss and being able to put money aside for his family. Although he’s as well positioned as anyone to see the impact of the new system, even if he doesn’t decide to become a livestock farmer, it seems like a good time to be a builder in Ea Kar too.

Smallholder farmer Nguyn Hui Nhon in Vietnam’s Ea Kar district, with some freshly harvested, high-quality forage.



Agricultural transformation in Ethiopia and beyond

There is a revolution taking place in East Africa. At its center, lies the humble white pea bean – and a market-led approach that is transforming agriculture, stirring institutional change, and stimulating economic growth.

At Tuka Langano village in Ethiopia's Oromia region, Milko Bati sits on her veranda. She used to live a hand-to-mouth existence, barely able to grow enough food to feed her seven children, let alone send them to school. Today, her children are at the top of their class; she has built a new two-room home complete with an iron sheet roof; and she has expanded her 2-hectare farm to include oxen, donkeys, cows, sheep, and goats – all thanks to beans.

Milko's story is not unique. She is one of thousands of smallholder farmers who switched to improved white pea bean varieties, kick-starting the evolution of Ethiopia's bean industry into a US\$50 million – and growing – export business.

Laying the building blocks

Before 2004, the Ethiopian Institute of Agricultural Research (EIAR), in partnership with CIAT under the Pan-Africa Bean Research Alliance (PABRA),² developed high-yielding bean varieties suitable for Ethiopia's diverse growing conditions and released them. The beans were well received by farmers, but the normal channels through which seeds were disseminated couldn't even meet 1% of farmers seed needs.

Kidane Tumsa, head of the Ethiopian National Bean Research Program (ENBRP) at EIAR explains: "While the market was demanding better quality beans, most farmers were still growing poor-quality, low-yielding beans and using poor crop management practices. What farmers needed was support to grow good quality produce more efficiently. Improving access to seed wasn't enough; we also had to address the bottlenecks along the value chain."

In collaboration with CIAT, EIAR formed a partnership with all the players in the bean industry, including farmers, research institutes, grain traders, community associations, nongovernment organizations (NGOs), seed producers, and policy makers. Together they identified the major obstacles preventing growth in the industry – including limited access to improved bean seed – and decided to take joint responsibility for developing the sector.

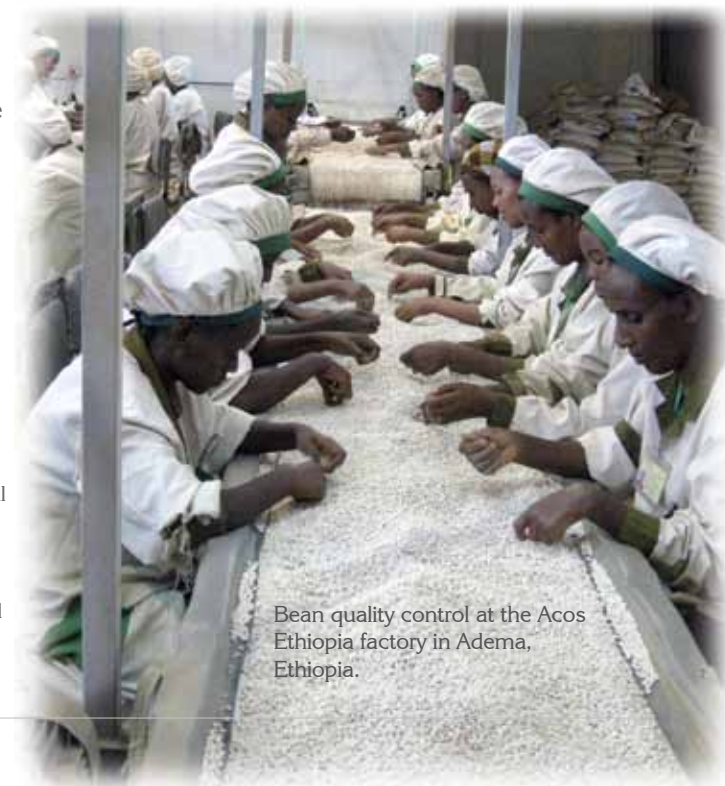
A partnership for change

As the bottlenecks to seed production and distribution were removed, the ENBRP started working with NGOs and farmer cooperatives to promote good agronomic practices, such as

adequate planting density and timely weeding. The partnership then began developing links between farmers and grain buyers, which helped to stabilize previously volatile prices.

From there, the ENBRP engaged with policy makers, who, recognizing that beans could benefit farmers, traders, and the country, listed them on the Ethiopian Commodity Exchange, guaranteeing farmers the international market price for their beans.

Between 2004 and 2012, the area of land used for growing beans in Ethiopia increased from 181,600 to 330,000 hectares, and bean production more than



Bean quality control at the Acos Ethiopia factory in Adema, Ethiopia.

tripled to 387,000 tons per year. Similarly, average yields increased from 0.62 tons per hectare to 1.5 tons; farmers increased their income (more than sixfold) from US\$120 per ton of beans to \$750; and the number of people employed to sort, process, and transport beans quadrupled to 12,000.

Domino effect

The development of Ethiopia's bean market is just the tip of the iceberg. The approach has been so successful that not only has it been applied to other crops in Ethiopia, including chick pea, wheat, and sorghum, but it's also spreading to other countries.

Kennedy Muimui, a bean breeder from the Zambia Agricultural Research Institute, said: "Just 2 years after we released new bean varieties suitable for canning onto the market, the Zambian Government declared that all seed sold by breeders and seed suppliers must be of certified quality – for all agricultural products. By engaging with the government from the outset, we've already had a huge effect on Zambia's agriculture. It's an amazing outcome. We've still got a lot of work to do to develop the industry, but the future is looking very bright."

Introducing new, improved varieties is only part of the solution to enhancing food security and incomes for Africa's bean farmers. By looking at the bigger picture and working with partners to embed the strengthening of supply chains into the national agenda, CIAT is helping to create sustainable change, allowing farmers like Milko Bati back in Ethiopia to think about investing in a horse cart next bean season instead of worrying about how she will feed her children.



Feeding Africa's livestock revolution

Across much of Africa, livestock are seriously undernourished. Not until they are well fed, will the millions of people who depend on these animals also begin to thrive.

CIAT research in several countries of Eastern and Central Africa confirms that tropical forages have a lot of potential to help overcome the animal feed shortage – one of Africa's main obstacles to improved livestock productivity and higher farm incomes. To deliver ample proof of this potential, the Center has developed a strategy with four key features aimed at reducing constraints to farmer adoption of introduced forages.

Grasses – Forage scientists will mainly promote productive forage grasses for zero-grazing livestock systems. Some of the grasses originated in Africa were later improved in Latin America by CIAT and others, and are now coming home with added value.

Value chains – Focused on high-potential value chains involving dairy cattle and goats as well as fattening of small ruminants and cattle for meat production, the new strategy will not just address individual constraints in forage production but make the whole feeding system more eco-efficient.

Partnerships – CIAT's forage expertise complements that of the Kenya-based International Livestock Research Institute (ILRI). The two centers are addressing Africa's livestock feed source constraint in close collaboration with national and local partners in the CGIAR Research Program on Livestock and Fish.

Farmer participation – This is an essential ingredient for successfully incorporating forages into livestock value chains and particularly for enhancing women's benefits from crop and livestock management as well as from the sale of farm products.

CIAT's recognized experience with farmer participatory methods together with its global expertise in forages and strong partnerships will translate into major benefits for millions of African smallholders in the years to come, with environmental gains as a large bonus.

Results *in* the Ground

Quesungual – Remember the name and not just for Scrabble

When Hurricane Mitch struck Honduras in 1998, torrential downpours triggered landslides that wiped out huge areas of crops. This compounded problems of malnutrition in some rural areas caused by an intense El Niño-driven drought the year before. But some smallholder farmers suffered only minor losses or none at all: they were practicing Quesungual.

Relatively easily established but biologically complex, Quesungual is an agroforestry system for hillsides that combines traditional knowledge with new insights into land management, while offering a sustainable alternative to slash-and-burn. As well as helping improve and protect soil fertility and food production, the system can help smallholders adapt to the kinds of extreme weather expected to become more frequent as a result of climate change.

Slash-and-mulch

In the early 1990s, the Food and Agriculture Organization of the United Nations (FAO), together with farmers and organizations in Lempira Department of Honduras, jointly developed and began promoting Quesungual. The double whammy of El Niño and Mitch was a formidable trial by fire and provided the proof of Quesungual's resilience that many farmers needed to adopt it.

Quesungual sees different kinds of trees scattered at a density of up to 1,000 per hectare of cropland. The roots act as deep anchors, stabilizing hillsides, minimizing soil erosion, and improving nutrient uptake from deeper soil layers. Most of the trees are heavily pruned at regular intervals, and the green cuttings are laid aboveground as nutritious mulch that also helps retain moisture – giving crops some protection against failed rains. This also helps increase soil organic matter, which encourages biological activity and nutrient cycling while improving soil structure.

Some of the trees are kept so small it's hard to spot them for the maize or sorghum that tower above. Others are left to grow big enough to provide timber and fruits. As well as capturing carbon dioxide, many of the trees promoted in the system fix nitrogen. The overall result is a more reliable production system – come rain or shine.

While there are some tradeoffs as young trees compete with crops for water, nutrients, and light, increases in crop productivity are maintained for many years, compared to slash-and-burn. CIAT soil scientist Steve Fonte has worked extensively in Lempira to validate the science behind the system:

“Very soon after establishing Quesungual, you see significant improvements in soil quality and stability,” he said. “In tropical areas, trees grow and soil conditions change rapidly, so farmers quickly see the benefits. We’ve been told that not long ago, if you’d looked out across these hills you’d have seen a continuous haze of smoke, as farmers burned their land in preparation for planting. Now the air remains pure and the hillsides green – almost everyone is practicing Quesungual; they’re convinced it works.”

Preliminary studies show that the system could work in other subhumid tropical regions, including parts of Haiti, Democratic Republic of the Congo, Ethiopia, and Burma, but according to CIAT agro-ecologist Aracely Castro, the institutional context will also be critical for adoption.

“A major reason for the success in Honduras was the strong support of local and international institutions, community leaders, schools, and churches to spread the message – as well as the painful experience of food insecurity in the early 1990s.

“So while the biophysical conditions are right for Quesungual in many countries, successful introduction and dissemination will depend on other factors.”





Mimicking nature

With trees of different types and heights scattered around a hillside of maize, for example, a Quesungual system can, at first glance, seem somewhat disorderly. But while it's tempting to equate an efficient, productive agricultural system with one that exhibits symmetry, or orderly patterns of crops that are pleasing to the eye, systems like these are not always the most sustainable.

“Quesungual mimics the functional diversity of natural landscapes, while combining the benefits of sustainable land management practices,” continued Castro. “Its beauty is therefore systemic rather than aesthetic, and that’s where the real attraction of the system lies.”

CIAT’s work on Quesungual in Central America has been funded by the CGIAR Challenge Program on Water and Food (CPWF), the Food and Agriculture Organization of the United Nations (FAO), the Austrian Development Agency (ADA), the United States Agency for International Development (USAID), and the German Agency for International Cooperation (GIZ) GmbH, Federal Ministry for Economic Cooperation and Development (BMZ).

Quesungual practitioner Miguel Cruz checks the sorghum on his farm in Lempira Department, Honduras.

Africa in the forefront of soils research

Four years ago, a group of CIAT-led scientists embarked on an ambitious project to assess soils across sub-Saharan Africa. The aim was to produce detailed digital maps that aid the development of site-specific recommendations to boost food production.

As the first phase of the Africa Soil Information Service (AfSIS) draws to a close, those maps are now available, giving scientists and policy makers new tools to make better land management decisions (www.africasoil.info).

Previously, recommendations about fertilizer use and other aspects of crop management were based on data collected from different sources, each of differing quality, and using different methods and languages. The new digital soil maps and associated databases – quite literally the result of groundbreaking work – mean that soil and crop management decisions can now be made more accurately.

CIAT soil scientist Leigh Winowiecki explains: “The objective was to build something completely new using unbiased sampling. So, as well as working with traditional research partners at familiar sites, we reached out to new partners and communities, and

created new test sites. Whereas some soil research is desk-based, with AfSIS we’ve quite literally taken soil research back to the ground.”

Researchers now have a solid foundation on which new studies and collaborations can be built, for example, exploring the complex interactions between soils, climate change, and livelihoods. Importantly, AfSIS has also placed Africa and African scientists at the forefront of soils research. With support from the Bill & Melinda Gates Foundation and Alliance for a Green Revolution in Africa (AGRA), researchers have collected comprehensive, scientifically sound data on Africa’s soil and land resources that simply didn’t exist before. The variables include soil organic carbon, pH, cation exchange capacity, erosion prevalence, and root depth restrictions for sites extending from semi-arid lands in

Kenya, to tropical wet forests in Cameroon and Guinea, to the savannas of Mozambique and Zambia.

Breaking new ground

In Arusha, Tanzania, AfSIS developed a strong relationship with the national agricultural research team. Eleven lab technicians from Tanzania were trained in the most advanced soil-testing techniques to analyze more than 12,000 soil samples from across East Africa. This, coupled with the development of infrared spectroscopy – a technology that makes soil testing quicker, cheaper, and more reliable – has enabled the Arusha laboratory to become self-sufficient in soil testing. In 2012, technicians independently analyzed 7,000 non-AfSIS soil samples, a 10-fold increase over previous years. Similar work has been undertaken in national research centers in Mali and Malawi.

As well as helping to boost technical capacity in African research institutions, the work is also feeding into new projects. Five CGIAR Research Programs – Water, Land and Ecosystems; Dryland Systems; Humidtropics; Forests, Trees and Agroforestry; and Climate Change, Agriculture and Food Security – are using land surveillance and soil-sensing approaches advanced by AfSIS, and this will help CIAT strengthen its own soil research program as well.

The groundbreaking work of AfSIS will result in more site-specific crop management recommendations for farmers.



The background of the page features a photograph of three farmers in a field at sunset. The sun is low on the horizon, creating a bright glow and silhouetting the figures. The farmer in the foreground is on the left, carrying a long wooden staff or pole across their shoulders. Two other farmers are visible in the distance, also carrying tools. The field is filled with green plants, likely corn.

From fields and farms to rural landscapes

Soil degradation is rampant across the tropical world – particularly in certain “hotspot” areas, such as Central America and much of Africa. Restoring soils and land to health across the tropics is a central requirement for reducing hunger and poverty through sustainable growth in agriculture.

In response to major challenges and opportunities, CIAT has revised its strategy for soils research, with the aim of expanding this work into a global effort that covers sub-Saharan Africa, Southeast Asia, and Latin America and the Caribbean. The strategy will guide research across scales – from fields and farms to production systems and landscapes – to help achieve sustainable intensification of agriculture, while reversing land degradation, improving ecosystem services, and making agriculture climate smart.

To widen the impact of their work, CIAT’s growing team of soil scientists is building strategic public-private sector partnerships, while also forging closer ties with advanced research institutes for scientific capacity strengthening.

CIAT’s soils research will cut across major crops and production zones in sub-Saharan Africa, Latin America, and Southeast Asia, representing a truly global soils program.

Climate Change Exposés

Tortillas on the roaster

Higher temperatures and changes in rainfall patterns threaten the livelihoods of one million maize and bean farmers, according to a pioneering report published in October 2012 by scientists at CIAT and the International Maize and Wheat Improvement Center (CIMMYT), as part of a project led by Catholic Relief Services (CRS).

Exposing the risks

Tortillas on the Roaster, funded by the Howard G. Buffett Foundation, exposes the risks of climate change to the two most important food crops in Nicaragua, Honduras, El Salvador, and Guatemala. The first study of its kind to make such highly specific, local-level predictions, it shows that an expected average temperature increase of around 1 degree Celsius by 2020 will severely affect maize, exacerbating water shortages and causing the plants to suffer from heat stress. Large swaths of the current maize-growing area could become unsuitable for the crop, resulting in economic losses to the region as a whole of around US\$100 million per year.

Crucially for maize, the biggest losses will occur where there is already severe soil degradation, as in parts of Honduras and throughout El Salvador, which could see production slump by about one-third in the next 10 years. Meanwhile, higher temperatures could extend the region's dry season, clashing with a crucial stage in the maize production cycle.

For beans, there is a serious threat of reduced rains during the planting season in September, with higher temperatures affecting flowering and seed production, which could reduce yields in all four countries by as much as 25%.

"Even with our most conservative estimates, it's clear that climate change could transform the agricultural landscape across Central America," said CIAT climate scientist and lead author Anton Eitzinger. "Conditions are already tough; it's one of the poorest and most vulnerable parts of Latin America."

Back to basics

The report highlights the importance of environmental management, finding that farmers

who employ good soil management practices, for example, will be better able to buffer the impacts of climate change, and produce a variety of lucrative crops. But those in marginal areas, with poorly managed farms could be forced to change their practices or leave agriculture altogether.

"The report highlights that there is no quick fix," said Paul Hicks, regional coordinator of CRS's Global Water Initiative-Central America. "This is about getting back to basics. Extension services across the region need to be reinvigorated to train small farmers in soil and water management. And governments need to lead; they have the ability to make a real difference through setting climate-smart agricultural policies."

Better use of rainwater – for example, through water harvesting – together with improved soil management, crop diversification, and the use of sustainable and so-called "climate-smart" approaches could help farmers do more than simply weather the storm.

Eye in the sky – Terra-i keeps track of deforestation

The recent launch of Terra-i, a near real-time deforestation-monitoring system for Latin America, brings the hotspots of forest loss into sharp focus.

Based on satellite information from NASA, Terra-i can zoom-in on the region's forests to a resolution of 250 m x 250 m. It's smart enough to distinguish between natural losses and those caused by human activity and can also monitor habitat change in nonforested areas, such as savannas and deserts. Anyone can log in and watch what's happening – from anywhere in the world – and with images updated every 16 days, little escapes the all-seeing Terra-i.

Seeing REDD+

Developed by CIAT, The Nature Conservancy, King's College London, the University of Applied Sciences and Arts Western Switzerland – and funded by TNC – Terra-i is aimed at helping governments and decision makers in Latin America formulate new policies on forest and habitat protection and test the effectiveness of current ones. With agriculture a major driver of deforestation in the region, Terra-i can also help identify high-priority areas for the implementation of schemes involving REDD+ (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries).

While Brazil has had its own hi-tech deforestation-monitoring system in place since 2008, Terra-i is the first to cover Latin America as a whole, from Mexico to Argentina.

Already it has enabled scientists to focus on areas that often slip under the deforestation radar, for example, the Gran Chaco – a highland, dry forest spreading across Paraguay, Argentina, Bolivia, and parts of southern Brazil. The second most densely forested area in Latin America after the Amazon, it's a biodiversity hotspot and a living museum of plants, but its plight has been overshadowed by international focus on its neighbor, the Amazon itself.

Launched in mid-2012, Terra-i revealed that around 1 million hectares of forest had been lost in the Gran Chaco during 2004–2010, driven by the expansion of soy plantations together with the displacement of

cattle ranchers into the region by industrial agriculture at the perimeter.

“The rates of deforestation in the Chaco were a huge surprise to us,” explained Terra-i team leader and CIAT researcher Louis Reymondin. “There's so much focus on the Amazon – and rightly so – but what we witnessed in the Chaco was much more severe than anywhere in the Amazon.”

A low-cost high-tech tool

Open source and free of charge, Terra-i means lower-income countries in Latin America now have the chance to monitor deforestation themselves. In late 2012, the Terra-i team trained technicians from the Bolivian government on how to use the system.

“Until now, satellite-based deforestation monitoring has been prohibitively expensive for many developing countries, and many of these countries are the most vulnerable,” continued Reymondin. “With Terra-i, we're aiming to put the technology in the hands of the people who need it most.”

In 2013 the team hopes to rally support to develop the system for other parts of the world, helping monitor deforestation high-risk areas in Borneo and the Democratic Republic of the Congo.

CIAT researchers discuss Terra-i, a deforestation-monitoring system for Latin America and, potentially, the rest of the tropics.

Colombia and CIAT – Partnering with a Purpose

Ecosystem signposts in Orinoquia

In a place as vast as Colombia's Eastern Plains, it's fairly easy to go astray, whether you're just crossing unmarked territory or staying put to manage the land.

With the aim of charting a sustainable path forward for land management in this region, researchers with CIAT and the Colombian Corporation of Agricultural Research (CORPOICA) have just completed a study that examines the effects of different land uses on soil-based ecosystem services. Situated in the Orinoco River Basin, the Eastern Plains are also commonly referred to in Spanish as the Orinoquia.

Until recent decades, the region was dominated by extensive cattle ranching on grassland savanna and low-input traditional agriculture. But now that is changing, as burgeoning demand for food, feed, fiber, and biofuel drives modern agriculture into one of the world's few remaining reserves of arable land.

Land use has branched out in many directions, with ambitious entrepreneurs converting large swathes of natural savanna to intensive commercial production of grains (rice, soybean, and maize), biofuel feedstocks (sugarcane and oil palm), and rubber. Over the last 2 decades, an estimated

50,000 hectares of savanna have been brought under cultivation, and recent data suggest that agricultural expansion is accelerating.

Paradise lost?

Commercial agriculture in Orinoquia is directed at a clear economic cardinal point. What no one knows for sure is what this will do to the environment in such an ecologically sensitive region.

Because of highly compacted and naturally acid soils, the study explains, intensive crop production in Orinoquia requires deep tillage and heavy applications of lime for crop production. This is often followed by the use of chemical fertilizers and pesticides. Such abrupt changes make the soil more susceptible to erosion and biodiversity loss, while also posing a potential threat to the region's waterways and adjacent gallery forests as a result of deteriorating water quality.

This is a familiar story for anyone who knows about agricultural development in the savannas of the Brazilian Cerrado. Over the last 2 decades, enormous gains in the crop productivity of that region have gone hand in hand with extensive environmental degradation. Will a paradise lost be the price that

Colombia pays for converting the Orinoquia into another commodity powerhouse for the world?

Staying on track

The Colombian government has voiced strong commitment to sustainable agricultural development in Orinoquia. But aware that good intentions are not enough, the country's Ministry of Agriculture and Rural Development (MADR) has given high priority to research on ecosystem services through an ongoing strategic alliance with CIAT and CORPOICA.

"Some of the new practices we've developed actually improve soil quality by enhancing biodiversity and biological activity in the soil," said Elcio Guimarães,



CIAT's regional coordinator for Latin America and the Caribbean. "But we must also provide decision makers with knowledge about the impacts of land use change to keep Orinoquia on track toward sustainable agricultural growth."

To that end, researchers analyzed different types of ecosystem services (such as water storage, climate change mitigation, and maintenance of soil biodiversity) under several rapidly expanding land uses in comparison with natural savanna. From data on the soil's chemical and physical properties as well as its macrofauna, the researchers created a set of "synthetic indicators," which, like signposts, indicate the direction in which ecosystem services are going.

More or less as expected, the researchers found none of the land uses to be necessarily misguided environmentally: "Each one favors one or a few ecosystem services, but there are clear tradeoffs," said CIAT soil scientist Steve Fonte, a co-author of the study. "While perennial crops proved well suited for water and climate regulation, annual cropping performed best in terms of nutrient supply, and improved pastures enhanced soil structure and associated communities of soil macrofauna" (earthworms, termites, and ants), which the authors refer to collegially as "ecosystem engineers."

To improve all ecosystem services, the study urges land users to organize the agricultural territory in

such a way as to alternate different land uses through rotation and the spatial arrangement of field plots. "This is especially important," Fonte stressed, "for preserving intricate networks of streams and gallery forests and the ecological functions associated with these landscape components."

The study also underlines the importance of continuous monitoring of soil quality and ecosystem services, using scientific signposts to help land managers make course corrections and avoid getting irretrievably lost.

Soybean trials at Carimagua in the heart of Colombia's Eastern Plains.



Biopacific Park – Toward a culture of competitive strength

In recent years, CIAT has entered into new strategic alliances with Colombia, aimed at responding effectively to the challenges of our host country's diverse agriculture.


One of those alliances centers on the Biopacific Park, which will foment agricultural development in southwestern Colombia and beyond through a collaborative research platform. Established in 2011 with strong support from the municipal government of Palmira and departmental government of Valle del Cauca, the Park quickly began to take shape in 2012.

With a comparative advantage in agroindustry, the Park will concentrate on knowledge-oriented development of competitive enterprises based on the life sciences. It will also serve as a center of excellence for innovation, bringing together universities, other research and technology development organizations, public and private enterprises (in Colombia and abroad), and agencies of local and national governments. Above all, the Park will promote a culture of research, innovation, and competitive strength among the businesses and other organizations associated with it.

Those efforts will build on the significant capacity in research, education, and scientific services of the organizations that constitute the Park, which employ about 1,400 professionals, including 400 with PhDs. In 2012, the Park laid the basis for its future work, obtaining legal status, defining its field of action, and building strategic alliances. Now, in 2013, the Park is entering a consolidation phase centering on the elements described as follows.

Portfolio of services – These will be oriented primarily toward the incubation of innovative technology-based enterprises. Toward this end, the Park has obtained significant funds from Colciencias (Colombia's Administrative Department of Science, Technology, and Innovation) to develop strategies for promoting and marketing the Park's services.

Research agenda – This is taking shape around key challenges in Colombia's southwestern Pacific region, particularly the need to boost the incomes of farmers in hillside areas through improved production of tropical fruits and horticultural crops. The Park's key allies in this effort include Vallenpaz



Yellow passion fruit
(*Passiflora edulis* f. *flavicarpa*).

and Alsur, local organizations that are well regarded for their work with rural communities.

Physical facilities – These are being designed with funding from the Inter-American Development Bank (IDB) in collaboration with the Colombian Presidential Agency for International Cooperation, which is supporting studies that will provide the basis for the Park's master plan and international business strategy.

All aboard!



Parque
bioPacífico
Investigación e Innovación para el Desarrollo

Since the 2011 inauguration of Biopacific Park, which was attended by Colombian President Juan Manuel Santos, it has gained support from the governments of Cauca, Chocó, and Nariño departments.

In addition, a group referred to as "G11 Regional" (representing the municipalities of Cali, Jamundí, Buenaventura, Palmira, Candelaria, La Cumbre, Yumbo, Dagua, Florida, Pradera, Vijes, Ginebra, and El Cerrito) has joined forces with the organizations that originally promoted the Park. The latter include the Ministry of Agriculture and Rural Development, departmental government of Valle del Cauca, Palmira mayor's office and Chamber of Commerce, National University of Colombia, University of Valle, Colombian Institute of Agriculture (ICA), and Colombian Corporation of Agricultural Research (CORPOICA), along with CIAT and FUNDACIAT.

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Phone: +57 2 4450000, ext. 3085

Partnership platforms

Two other key mechanisms through which CIAT enhances research partnerships that contribute to agricultural development in Colombia and other countries are the Agronatura Science Park and FUNDACIAT (CIAT Foundation). Agronatura brings together 12 national and international organizations to constitute a platform for creating new alliances around shared research and development priorities. The CIAT Foundation, as a member of Agronatura, helps strengthen the research agenda of national partners in Colombia, with emphasis on the transfer of CIAT research results to end-users.

Agronatura Science Park

Alexander von Humboldt Biological Resources Research Institute (Instituto Humboldt)

Phone: +57 2 4450000, ext. 3174



Bioversity International

Phone: +57 2 4450048 / 49

Fax: +57 2 4450096



CLAYUCA Corporation

Phone: +57 2 4450000, ext. 3159



Colombian Institute of Agriculture (ICA)

Phone: +57 2 4450000, ext. 3136



Colombian Sugarcane Research Center (CENICAÑA)

Phone: +57 2 6876611



Catalyzing public-private partnerships

In recent years, CIAT has sought to engage productively with the private sector, aiming primarily to enhance the impact of our research across the developing world. Described briefly below are public-private partnerships that are already delivering or promise to deliver important results.

Adding value to cassava – In 2006, CIAT researchers discovered an amylose-free cassava type, whose special starch properties create the possibility of new industrial uses for the crop. Several years later, the Center entered into a public-private partnership with Ingredion Incorporated, USA, to explore the commercial possibilities of so-called “waxy” cassava. As demand is created for specialty products based on this cassava, farmers should be able to boost their incomes by selling the improved varieties at premium prices compared to conventional cassava.

Gaining ground with grass hybrids – In response to rapidly rising global demand for livestock products, CIAT is developing new hybrids of *Brachiaria* grasses, which enhance livestock productivity and also deliver environmental benefits. Under an agreement reached in 2011, new *Brachiaria* hybrids will be marketed on a large scale by Dow AgroSciences LLC. While focusing especially on tropical America (with the exception of Colombia), the two partners will also make special efforts to deliver hybrids for Africa, where *Brachiaria* grasses originated.

Corporation for the Development of Biotechnology (Corporación BIOTEC)

Phone: +57 2 4450000, ext. 3114



Foundation for Agricultural Research and Development (FIDAR)

Phone: +57 2 4450000, ext. 3106



FUNDACIAT (CIAT Foundation)

Phone: +57 2 4450085 / 92



International Maize and Wheat Improvement Center (CIMMYT)

Phone: +57 2 4450025



Institute of Marine and Coastal Research “José Benito Vives de Andrés” (INVEMAR)

Phone: +57 2 4450000, ext. 3112



Latin American Fund for Irrigated Rice (FLAR)

Phone: +57 2 4450052 / 93



Connecting with Colombia's scientific diaspora

Since its inception, CIAT has contributed importantly to strengthening the research capacity of partner organizations around the world. More than 5,000 professionals from Colombia alone have benefited from training offered by the Center. Many of those scientists, along with former Colombian staff of CIAT, have gone abroad to build outstanding careers in the public and private sectors, applying what they learned in the Center's fields and laboratories to make their mark in research for development.

As part of CIAT's 45th anniversary celebrations, we held an event to recognize the success of our Colombian alumni and to explore how we can strengthen our connections with them and learn from their experience through new partnerships. Participants also considered how the Center can work more closely with universities toward our shared aim of directing talented young people into agricultural research.

The event included a keynote speech by Ignacio Mantilla, rector of the National University of Colombia, and a panel discussion with selected CIAT alumni. The discussions yielded many concrete ideas about how the Center can fashion its extended family into a productive alumni network.

Research assistant Darwin Ortiz conducting cassava starch analysis in CIAT's Nutritional Quality Laboratory.

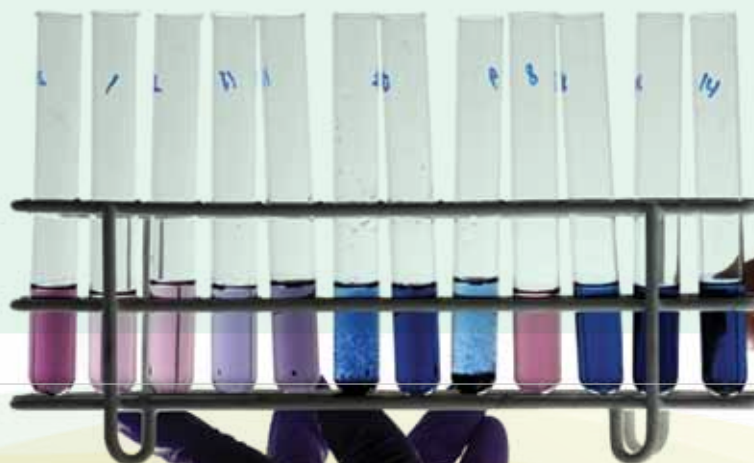
Understanding the wider regional context

CIAT, the Inter-American Development Bank, and other organizations joined forces in 2012 to create a "foresight framework" in support of strategic planning for agriculture in Latin America and the Caribbean (LAC). Summarized below are a few key findings from that work, which sheds light on emerging challenges and opportunities for Colombia and other countries of the region.

Global food basket – LAC accounts for a slightly bigger share of world agricultural production than the European Union or the USA plus Canada, and in the last decade, it has become the world's principal net food-exporting region. Simulation studies suggest that LAC will continue to have a significant influence on global food security.

Leader in environmental services – LAC is also the developing world's biggest provider of global environmental services. For that reason, rapid land use change in the region is a matter of great concern because of its effects on greenhouse gas emissions and on the region's rich stores of biodiversity. Several countries, including Colombia, have embarked on initiatives to reduce emissions from deforestation and forest degradation.

Agricultural R&D – This activity has evolved considerably in the region, leading in recent years to active roles for the private sector and civil society in technology development and diffusion. While public investment in R&D has also risen over the last decade, just a few countries, notably Brazil, account for much of the increase, and investment has declined in smaller countries where it is needed most. To strengthen its global contributions, LAC must intensify R&D along the whole agricultural value chain, widening the scope of this work beyond the staple crops produced by smallholders.



Research Publications

Articles and other information resources are among the primary means by which CIAT shares the results of collaborative research. Following is a selection from the total of 266 items published by Center scientists with partners in 2012; more than half of the total appeared in international refereed journals and books. The articles listed here represent the full breadth of Center research; most are already being cited in the literature, reflecting the relevance and high quality of our science.

Outstanding research publication award

In 2012, the recipient of this CIAT internal award was the journal article listed below, which provides new insight into the complex challenge of developing bean varieties that are more resilient both under drought and aluminum toxicity in acid soils.

Yang Z-B; Eticha D; Albacete A; Rao IM; Roitsch T; Horst WJ. 2012. Physiological and molecular analysis of the interaction between aluminium toxicity and drought stress in common bean (*Phaseolus vulgaris*). *Journal of Experimental Botany* 63(8):3109–3125. <http://dx.doi.org/10.1093/jxb/ers038>

Complete lists of scientific publications in 2012 and previous years as well as other information resources are available at: <http://ciatlibrary.blogspot.com/p/ciat-publications-2012.html>

Agrobiodiversity Research Area

Akinbo O; Labuschagne MT; Fregene MA. 2012. Increased storage protein from interspecific F_1 hybrids between cassava (*Manihot esculenta* Crantz) and its wild progenitor (*M. esculenta* ssp. *flabellifolia*). *Euphytica* 185:303–311. <http://dx.doi.org/10.1007/s10681-011-0590-z>

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CIAT Financial Highlights

CIAT's financial position continued to improve in 2012, as we successfully integrated the Center's research agenda with the work of all 12 CGIAR Research Programs to which the Center contributes – an achievement that reflected extraordinary efforts on the part of our research and administrative staff.

Financial results for 2012

As Lead Center of the CGIAR Research Program (CRP) on Climate Change, Agriculture and Food Security (CCAFS), CIAT strongly supported financial coordination and reporting during the second year of this multi-year program, in which 19 partners participate, including all 15 CGIAR centers and 4 universities. By the end of the year, 10 out of 12 Program Participant Agreements had been signed. The Center's Enterprise Resource Planning system was used to track and report research execution at the level of bilateral projects, the CRP, and CIAT's Institutional Program and Research Area.

CCAFS partners, including CIAT, successfully executed 95% of the Program's budget, giving a total of US\$65.8 million, of which \$48.9 million came from CGIAR Fund windows 1 and 2.³ The Center's research execution increased by almost 18%, as total revenues rose by more than 20% over last year's level, reaching \$109 million. This occurred despite the late start of fund disbursement from the

³ Donor contributions through window 1 of the CGIAR Fund provide overall support and are allocated to CGIAR Research Programs according to the Finance Plan proposed by the CGIAR Consortium and approved by the CGIAR Fund, while those going to window 2 are allocated by the donor to specific CGIAR Research Programs. Funds for bilateral projects are channeled through window 3 or contracted directly with the Center.

CGIAR Fund and Consortium and a temporary funding freeze in September-October, which had no lasting impact on CIAT's financial result, thanks to renewed financial strength. By early 2013, nearly all funds from CGIAR Research Programs were received, a significant improvement over the previous year's disbursement from Fund windows 1 and 2.

With few exceptions, all CCAFS partners provided timely financial reports, which favored implementation of the Program's fund disbursement plan. Consequently, CIAT was able to disburse windows 1 and 2 funds for CCAFS within less than 30 days after they were received from the CGIAR Fund and Consortium.

As a result of opportune financial reporting to the Lead Centers of the CGIAR Research Programs in which CIAT participates, funds were received almost entirely in line with expectations. The only exception concerned the CGIAR Research Program on Rice, known as the Global Rice Science Partnership (GRiSP), which was unable to cover CIAT's full program costs, generating a shortfall of \$0.8 million in CIAT's rice and biotechnology programs.

CIAT's financial management was quite solid in 2012, reflecting careful efforts to protect our budget exchange rate against a continuously strengthening Colombian Peso (nearly 10% against the US dollar) as well as strict compliance with the investment policy approved by our Board of Trustees. As a result, CIAT's self-generated income amounted to \$4.2 million. This income, together with research execution above the level budgeted as well as full implementation of cost recovery, gave CIAT a surplus of \$5.4 million, enabling us to increase reserves from 86 days in 2011 to 100 days in 2012.

CIAT took an important step in 2012 toward urgent infrastructure renovation. We revalued our infrastructure for the first time, charging 20% of its commercial value, as established by our insurance company and based on the depreciation period, as per financial guidelines, in the form of depreciation to the direct cost of facility charges. This has put the Center on track toward re-establishing an infrastructure fund, which will eventually allow us to embark on high-priority upgrades. This step also moves CIAT closer to full compliance with International Financial Reporting Standards, which we expect to achieve by 2014.

Financial outlook for 2013

CIAT's budgeting process has become quite complex in recent years. The Center must forecast income from bilateral projects under considerable uncertainty, resulting from donor decisions to shift funds between windows 1, 2, and 3 of the CGIAR Fund and bilateral projects contracted directly with the Center. In addition, the Center must forecast income from 12 CGIAR Research Programs, each with a somewhat different planning cycle and set of allocation priorities.

The CGIAR Consortium's decision to guarantee 90% of window 1 and 2 allocations to those programs for the 2013 budget, based on 2012 execution levels, significantly facilitates the budgeting process. Assuming that window 1 and 2 funds are allocated in November at the latest, CIAT and other centers can prepare reasonable operating budgets for the following year.

In December 2012, CIAT signed an agreement with Colombia's Ministry of Agriculture and Rural Development for a significant project dealing with agriculture and climate change. Its budget amounts to \$9 million to be executed with six local and international partners, for which 40% of the funds are allocated.

This project, which was not anticipated in CIAT's 2013 budget, should have a decidedly positive impact on the year's research execution.

The 2013 budget approved by CIAT's Board of Trustees indicates \$95.1 million in revenues, of which \$36.7 million are for CCAFS partners, excluding CIAT and non-CGIAR partners. With respect to funds from CGIAR Research Programs and their confirmed window 2 allocations, the budget assumes, conservatively, that CIAT will receive amounts that are between 90 and 100% of last year's funding. The budget shows a net surplus of \$1.1 million – enough to add 4 days to our total number of operating reserve days. We expect the Colombian currency to strengthen slightly and have already taken action to protect the budgeted expense rate for the first 6 months of the year.

Statement of Financial Position

December 31, 2012 and 2011

(US\$ in thousands)

	2012	2011
Current assets	58,589	50,966
Non-current assets	27,691	24,653
Total assets	86,280	75,619
Current liabilities	58,277	53,575
Non-current liabilities	2,644	2,230
Total liabilities	60,921	55,805
Undesignated	13,962	10,282
Designated	11,232	9,512
Temporary net assets (forwards)	165	20
Total net assets	25,359	19,814
Total liabilities and net assets	86,280	75,619

Statement of Activity December 31, 2012 and 2011 (US\$ in thousands)

	2012	2011
Grants	104,457	85,280
Other revenues and gains	4,269	2,933
Total revenues and gains	108,726	88,213
Program-related expenses	94,302	79,564
Management and general expenses	7,542	6,171
Other losses and expenses	1,804	1,713
Subtotal expenses and losses	103,648	87,448
Indirect cost recovery*	(322)	(647)
Total expenses and losses	103,326	86,801
Net surplus	5,400	1,412

* Change of reporting implemented in 2012.
2011 is restated to reflect the changes implemented in 2012 reporting.
Amounts reported represent recovery from unrestricted funds.

Operating Expenses by Natural Classification and Days of Reserve December 31, 2012 and 2011 (US\$ in thousands)

	2012	2011
Personnel costs	29,161	28,738
CRP CGIAR center partnership costs	35,618	27,380
Non-CGIAR center partnership costs	16,353	11,748
Supplies and services	15,851	12,843
Operational travel	4,603	4,502
Depreciation of fixed assets	1,909	2,169
System cost CSP	153	68
Indirect cost recovery*	(322)	(647)
Total operating expenses, net	103,326	86,801
Days of reserves	100	86

* Change of reporting implemented in 2012.
2011 is restated to reflect the changes implemented in 2012 reporting.
Amounts reported represent recovery from unrestricted funds.

Donor Support

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the promise of tropical agriculture through high-quality science that reduces hunger and poverty while enhancing natural resource management.

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Thai Tapioca Development Institute (TTDI)
The Nippon Foundation, Japan

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Climate and Development Knowledge Network (CDKN), UK
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Compañía Agrícola Colombiana Ltda. & Cia S.C.A.
Government of the Department of Nariño, Colombia
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Project for Strategic Development of Natural Resources (Proderm),
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Technical Centre for Agricultural and Rural Cooperation (CTA),
The Netherlands
University of the Valley of Guatemala

CIAT Today

The International Center for Tropical Agriculture (CIAT), working in collaboration with hundreds of partners across the developing world, develops technologies, methods, and knowledge that better enable farmers, mainly smallholders, to enhance eco-efficiency in agriculture. This means we help make production more competitive and profitable as well as sustainable and resilient through economically and ecologically sound use of natural resources and purchased inputs.

Since no single organization can address the whole of tropical agriculture, CIAT complements the efforts

of others by focusing strategically on selected crops and research areas. Our scientists work globally to develop more resilient and productive varieties of two key staples, cassava and common bean, together with tropical forages for livestock. In Latin America and the Caribbean, we also improve rice production. Representing diverse food groups and a key portion of the world's agricultural biodiversity, the crops CIAT improves are vital for global food and nutrition security.

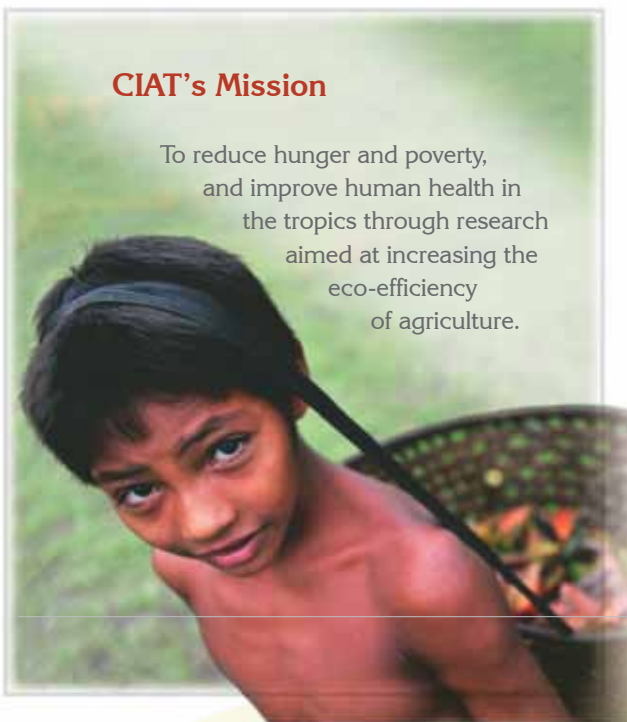
In our research on agrobiodiversity, we rely on advanced biotechnology to accelerate crop improvement. Progress in this work also depends on unique collections of genetic resources – 65,000 crop samples in all – which we hold in trust for humanity.

CIAT works in two other key areas – soils and decision and policy analysis – which cut across all tropical crops and production environments. Our soil scientists use the latest tools and knowledge to improve soil health, restore degraded land, and make agriculture climate smart. Through our work on decision and policy analysis, we harness the power of information to influence decisions about issues such as climate change, environmental management, linking farmers to markets, and gender equity.

CIAT scientists work in Latin America and the Caribbean (LAC) as well as 29 countries of sub-Saharan Africa, and 5 of Southeast Asia. In LAC, we work in several distinct environments – Colombia's Orinoquia region, Central America, the Amazon, and parts of Brazil – where CIAT's integrated research is especially relevant. Our research for Africa focuses primarily on common bean, soils, and tropical forages, while in Asia, we concentrate on cassava and tropical forages in smallholder rainfed systems of the Greater Mekong region.

CIAT's Mission

To reduce hunger and poverty, and improve human health in the tropics through research aimed at increasing the eco-efficiency of agriculture.



CGIAR Global Research

CIAT is a member of the CGIAR Consortium and Lead Center of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). The Center contributes importantly to other CGIAR Research Programs as well.


CGIAR is a global partnership that unites organizations engaged in research for a food secure future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources. It is carried out by the 15 centers who are members of the CGIAR Consortium in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia, and the private sector.

CIAT's Contribution to the CGIAR Research Programs

CGIAR's new Research Programs (CRPs) tackle cross-cutting issues in agricultural development around the globe, aligning the research of its 15 research centers and their partners into efficient, coherent, multidisciplinary efforts. CIAT, as a member of the CGIAR Consortium, contributes to 12 of these CRPs, including leading the program on Climate Change, Agriculture and Food Security.

- CIFOR Center for International Forestry Research
- CIP International Potato Center
- ICARDA International Center for Agricultural Research in the Dry Areas
- ICRISAT International Crops Research Institute for the Semi-Arid Tropics
- IFPRI International Food Policy Research Institute
- IITA International Institute of Tropical Agriculture
- ILRI International Livestock Research Institute
- IRRI International Rice Research Institute
- IWMI International Water Management Institute

Grain Legumes
Led by ICRISAT



Maximize the benefits that grain legumes—common bean, pulses, and oilseeds—offer to smallholder farmers, especially women.

CIAT's role: In sub-Saharan Africa and Latin America and the Caribbean, address constraints to common bean productivity, such as drought, low soil phosphorus and nitrogen, and rising temperatures, while also strengthening farmers' seed systems and market links.


Livestock and Fish
Led by ILRI



Increase the availability and affordability of meat, milk, and fish for poor consumers and raise the incomes of smallholders producing these commodities.

CIAT's role: Lead research on the dairy value chain in Central America and contribute to work on this value chain in Tanzania and on smallholder pig value chains in Vietnam and Uganda; improve livestock productivity in fragile environments through high yielding, high-quality tropical forages; and help reduce the environmental footprint of livestock production.

Humidtropics
Led by IITA




Transform the lives of the rural poor in the humid lowlands, moist savannas, and tropical highlands in tropical America, Asia, and Africa.

CIAT's role: Lead work on sustainable intensification and generation of ecosystem services in mixed crop-livestock-agroforestry systems in Central America and the Caribbean; lead the value chain, institutions, and markets theme; and carry out additional work in Southeast Asia, and East and Central Africa.



Climate Change, Agriculture and Food Security
Led by CIAT



Address the challenge of climate change and declining food security through strategic collaboration involving all CGIAR centers and Future Earth.

CIAT's role: As lead center, participate in climate impact modeling, adaptation planning and policy analysis, development of forage-based adaptation and mitigation measures, soil carbon assessment, and seasonal climate and crop forecasting.

Forests, Trees and Agroforestry
Led by CIFOR



Improve the livelihoods of smallholder farmers at the forest margins, while maintaining and building forest resources for environmental protection.

CIAT's role: Assess deforestation and land-use change for climate change mitigation, develop climate change adaptation pathways, and determine how to improve the livelihoods of marginalized groups at the forest margins.

Rice

Led by IRRI

Increase the productivity of rice, while improving the management of water and other resources on which production depends.

CIAT's role: Lead work in Latin America and the Caribbean, with a focus on genetic improvement of yield and quality, development and diffusion of new varieties, and enhancement of crop management.



Roots, Tubers and Bananas

Led by CIP

Improve nutrition, food security, and incomes of smallholder farmers producing root and tuber crops.

CIAT's role: Extend worldwide the benefits of cassava's genetic resources native to the Americas, with the aim of enhancing the productivity, profitability, pest and disease resistance, and nutritional value of the crop through agronomy, breeding, and biotechnology research.



Agriculture for Nutrition and Health

Led by IFPRI

Improve the nutrition and health of poor people by improving access to better quality foods; increasing the adoption of food safety procedures; and better integrating agriculture, nutrition, and health outreach programs.

CIAT's role: Through its leading role in HarvestPlus, develop and test nutritionally improved bean and cassava through biofortification, conducting the work in Latin America and the Caribbean through AgroSalud.



Research Areas

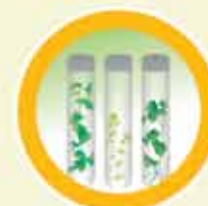
- Agrobiodiversity
- Soils
- Decision and Policy Analysis

Managing and Sustaining Crop Collections

Led by the Global Crop Diversity Trust

Collect and maintain 700,000 or more samples of crop, forage, and agroforestry resources held in gene banks at 11 CGIAR centers around the world.

CIAT's role: Maintain and distribute its collection of over 35,000 samples of common bean, over 23,000 samples of tropical forages, and over 6,000 samples of cassava.



Policies, Institutions, and Markets

Led by IFPRI

Identify evidence-based policies, inclusive institutions, and equitable and efficient markets that help smallholder producers in rural communities increase their incomes.

CIAT's role: In Central America and sub-Saharan Africa, sustainably link smallholder producers with buyers, and promote business practices that favor inclusion and poverty reduction; engage the public and private sector through research-in-development platforms.



Water, Land and Ecosystems

Led by IWMI

Work at the nexus of agriculture and the environment, examining methods to intensify farming and restore degraded lands, while using natural resources wisely to maintain ecosystem services.

CIAT's role: As co-leader of the rainfed research portfolio, support sustainable intensification while improving soil health, restoring degraded landscapes, and maintaining ecosystem services in Southeast Asia, sub-Saharan Africa, and Latin America and the Caribbean.



Dryland Systems

Led by ICARDA

Improve food security for the rural poor, protect the natural resource base, and empower small-scale farmers and pastoralists in areas with low rainfall.

CIAT's role: Conduct research to sustainably intensify food production across the dry areas of Africa, based on assessments of soil health and appropriate land management practices.



CIAT organigraph



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⁴ Retired from the Board in December 2012.

In memory of **Anthony Bellotti** (1937–2013), whose enormous professional accomplishments advanced the knowledge of cassava entomology from its infancy to maturity, opening the way for major contributions to improved livelihoods for cassava farmers around the world.

Staff

CIAT has a total of 858 staff, including 400 professionals, of whom 200 are scientists; 695 are based in Colombia or elsewhere in Latin America and the Caribbean (LAC), while 145 are in sub-Saharan Africa, 17 in Asia, and 1 in Europe. In the list that follows, staff members are based at Headquarters, Cali, Colombia, unless otherwise indicated.

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Andy Jarvis, Director, Decision and Policy Analysis Research Area
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Robin Buruchara, Regional Coordinator for Africa, Kenya
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Hernán Ceballos, Plant Breeder
Paul Chavarriaga, Molecular Biologist
Wilmer Cuéllar, Virologist
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* Left CIAT during the period covered by this report.

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