SCIENCE FOR PEOPLE AND THE PLANET

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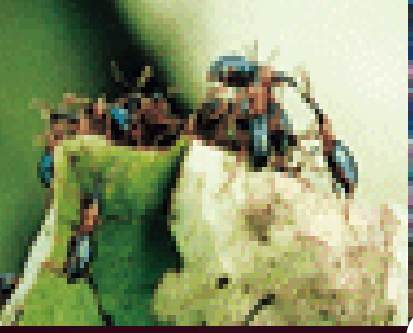


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From the Director General

The International Potato Center's Vision exercise, finalized in 2003, reaffirmed CIP's commitment to putting Center science squarely at the service of people and the planet. Despite the complexity of this commitment, and the vast concerns and issues it embraces, the exercise helped us to reaffirm our Center's capabilities, as well as our staff and partners' shared determination to contribute to the challenges laid out by the UN in the Millennium Development Goals (MDG).

The MDG provided CIP with the context for a very thorough process of self examination, helping us to identify the areas—within the broad range of challenges they set forth—where we were already closely aligned with the proposed

targets, as well as those where we needed to increase our focus or reshape our program to produce the results that our mission demands of us. Thanks to the strong leadership of Dr. Pamela Anderson, CIP's Deputy Director General for Research, we ended the year with a totally revamped research structure, realigned to provide maximum impact in the action areas identified by our Vision plenary. This new structure gives us a solid framework within which we can move forward to fine-tune our research activities: eliminating the superfluous (not in terms of absolute value but rather in terms of direct contribution to our carefully chosen targets), heightening capacities in key areas, and building the expertise and partnerships needed to face the challenges we have singled out head on. With six new Research Divisions, eight solid Partnership Projects, and a portfolio of emerging Country Development Projects, CIP is now fully prepared to make our new Vision a reality. Our donors have recognized this readiness by committing funds to important new undertakings and renewing their support for efforts already underway. Many of these initiatives are reported on in this publication.

As we progressed through this intense process of realignment, we were reminded that renewal is most effective when it is based on solid recognition and reinforcement of proven strengths. With this in mind, we grouped CIP's new program structure solidly around our longstanding core research areas: impact assessment and enhancement, genetic resources conservation and characterization, crop enhancement and improvement, and natural resources

management. Only one of the new Research Divisions represents an area that is, as such, new to CIP: human health. This is not to say that concerns for human health are new to us. Rather, the Vision exercise helped us to appreciate CIP's ample experience and effectiveness in working to improve human health, the enormous potential of our mandate crops for contributing even more significantly to it, and the viability—through partnering and pairing of strategic capabilities—of making a solid impact in this vital area of concern.

On another front, the Vision exercise confirmed the soundness of one of CIP's founding principles: the power of partnership. For us and for so many of our colleagues worldwide, time has proven that the only way to address the complex problems of the developing world, and to maximize each of our individual contributions to their solutions, is through innovative and effective cooperation. This is why we have raised the profile of partnership within our new program, giving renewed impetus to initiatives that will make key contributions to pressing concerns that would otherwise be far too vast for us to tackle. Among the Partnership Programs included in our new program are two CIP-led system-wide programs, five regional initiatives, and one global research network. CIP's partnerships also include active engagement in the three CGIAR Pilot Challenge Programs.

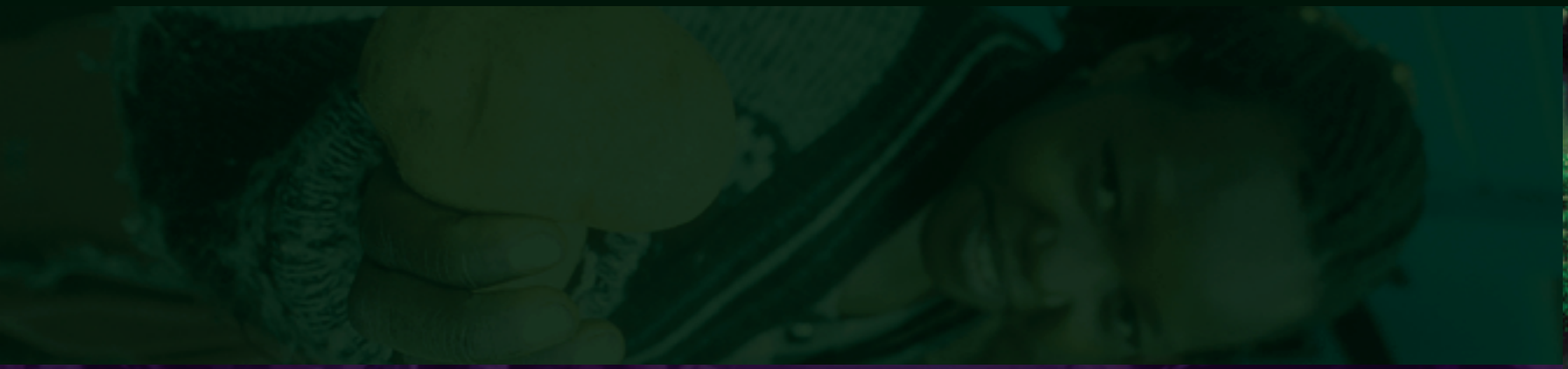
For CIP, 2003 also marked a return to financial stability. After several years of shortfalls resulting from unfavorable exchange rates and reductions in income, we were able to ensure

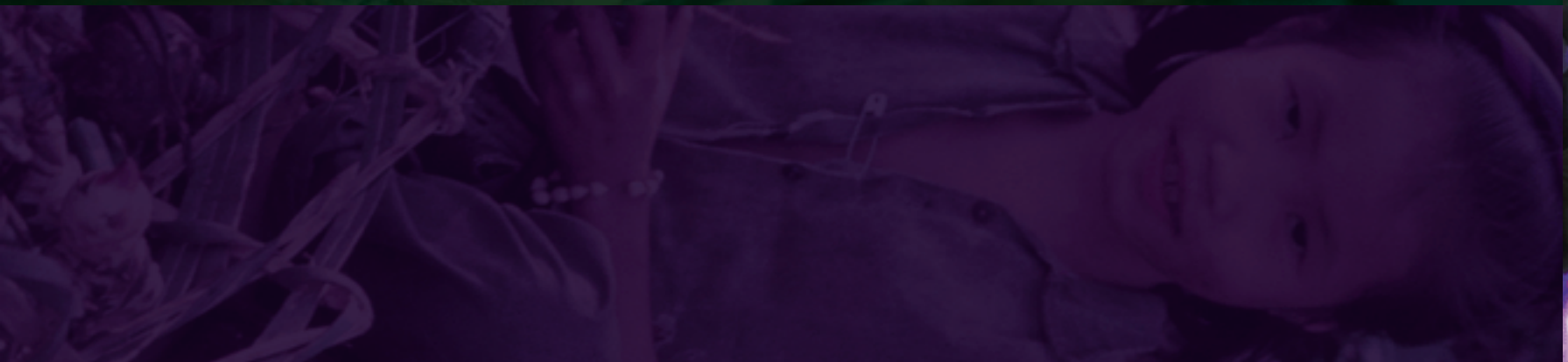
funds well over budgeted amounts and to rebuild our financial reserves. This was possible largely thanks to cost reduction measures initiated in 2002, combined with increased cost recovery from restricted projects. CIP foresees a healthy financial situation in 2004 with overall growth in revenues coming from an increased number and value of restricted projects, and a stronger pipeline of pending proposals.

On the system level, we are encouraged by the CGIAR's move to establish a strong Science Council capable of making enlightened recommendations to donors on priority setting and resource allocation. This, together with the consolidation of the Future Harvest Alliance office to integrate efforts across the system, will help us to make great strides, collectively and as individual Centers, toward our shared goals and mission.

In closing, I am most pleased that our Board of Trustees has elected Pamela Anderson to succeed me when I retire as Director General in 2005. Pamela's dedication and talent—and the opportunity we will have to work side by side in ensuring a smooth transition for CIP—will certainly contribute to making CIP's new Vision a source of positive, sustainable changes for the people and the planet we strive to serve.

Hubert Zandstra
Director General





SCIENCE FOR PEOPLE AND THE PLANET

In 2003 CIP completed its Vision exercise by realigning its research and development program for optimal impact (see *New Research Division Targets UN Millennium Development Goals*, page 15). The exercise reconfirmed the strength and relevance of CIP's long-established core research areas while highlighting the opportunity to consolidate efforts in other areas, human health in particular (see *New Research Division Integrates Crops, Environment, and Human Health*, page 33).

In accordance with this Vision, in 2003 CIP continued to give high priority to Africa, building up capacity and targeting opportunities to make a concerted impact in key urban and rural settings. A new series of potatoes derived from traditional Andean varieties showed great promise in helping farmers control late blight disease, while sweetpotato continued to make inroads in the battle against vitamin A deficiency (see *Harnessing the Trend: A Millennium Strategy for Africa*, page 57).

Also in Africa, Urban Harvest facilitated a two-year-long process of debate and

consultation among the members of the Kampala City Council. Their aim, achieved in 2003, was to develop a new set of ordinances to update the rules governing urban agriculture. Urban Harvest helped the diverse stakeholders to find ways around impasses while addressing the concerns of all the participating groups (see *Partners Move to Bring Urban Agriculture Above Ground in Sub-Saharan Africa*, page 51).

Bacterial wilt is second only to late blight in its impact on developing-country potato production. In 2003 CIP scientists advanced on many fronts in their work to empower developing country farmers and agricultural programs with measures that will allow them to control this devastating disease (see *CIP Scientists Set to Breach Age-Old Disease Barrier*, page 27). Center researchers also made the most of the tools of modern molecular biology to provide much needed solutions to other important, long-standing problems in Africa and Latin America (see *Advanced Technologies Readied for Potato and Sweetpotato Producers*, page 21).

In northeastern India, scientists sought to provide viable alternatives to expensive and difficult-to-transport potato tuber seed. In areas such as Nagaland, a remote tribal region of 20 million people—many of whom depend on slash-and-burn agriculture for subsistence—true potato seed provided the answer (see *Northeast Indian Farmers and Consumers Benefit from Novel Seed Technology*, page 63). Sweetpotato offered similar solutions to pressing livelihood problems in Asia. In Indonesia's Papua Province, a CIP-developed processing technique that helps farmers turn sweetpotato into nutritious pig feed heightened the efficiency of farm and family resources, and boosted family income (see *Sweetpotato Fermentation Process Aids Papuan Pig Farmers*, page 37).

Building on wide and innovative partnerships, CIP also made considerable advances in 2003 in its efforts to promote improved livelihoods and environmental health in the mountain regions of the world, particularly in the Andes (see *A Watershed Year for Natural Resources Management*, page 43).

We hope that you will enjoy reading about these advances, and that you will share our enthusiasm as we begin to shift gears, using CIP's new Vision to build on these successes and to increase our Center's impact and relevance.

New research division targets UN Millennium Development Goals

In an effort to help scientists contribute to the United Nations Millennium Development Goals, CIP established a new research division in 2003 to improve targeting and do a better job of monitoring impact

CIP's new Impact Enhancement Division, which will be operational by the end of 2004, will focus on research in 33 target countries covering eight regions and a variety of agro-ecologies. This is one of the key outcomes of the nearly 18 months of analysis and consultation involved in the Center's visioning exercise, through which CIP scientists and management concluded that the delivery of greater benefits to the poor will require a realignment of the way the Center targets and evaluates its research.

"CIP can no longer assume that simply increasing agricultural productivity will push people out of poverty or contribute to global development goals," says economist Keith Fuglie. "That assumption was fundamental to many of our past successes, but we now operate under vastly different circumstances. In today's world, productivity increases will not provide the leverage needed to crack hardcore poverty, reduce child mortality, or lessen the impact of global warming."

Fuglie, who heads the Center's new Impact Enhancement Division, notes that CIP's last priority-setting exercise, conducted in 1997, produced the first CIP strategy to explicitly address both poverty and environmental issues. That exercise, he says, led to a repositioning of Center research to the targeting of broad poverty-stricken areas in northeast India, Bangladesh, the interior provinces of China, and Central Africa. "Much of that research," says Fuglie, "is now contributing millions of dollars in benefits," (see *Impact of CIP-related technologies*, next page).

Impact of CIP-related technologies[1]

Technology		Country	Time span for project appraisal	Returns on investment[2]		
General	Specific			Internal rate of return (%)	Net present value (million $)	Poverty content (%)
Varietal	Late blight resistance and improved seed	Rwanda, Burundi, Zaire	1978–1993	92	27.0	85
	Resistance to drought and viruses	China	1978–2000	106	11.9	71
	Late blight resistance	Peru	1979–2020	27	5.4	31
Integrated pest management	Potato tuber moth	Tunisia	1976–2000	64	6.4	18
	Sweetpotato weevil	Dominican Republic	1989–2019	29	1.1	55
	Sweetpotato weevil	Cuba	1993–2020	65	21.7	32
	Andean potato weevil	Peru	1988–2018	32	1.8	31
Seed	Rapid multiplication and late-blight-resistant varieties	Vietnam	1978–1993	81	2.1	52
	True potato seed	India	1978–2015	29	18	60
	Sweetpotato-virus-free planting material	China	1978–2015	202	550	20
	True potato seed	Egypt	1979–2015	28	2.9	23
	True potato seed	Vietnam	1990–2010	39	1.8	52

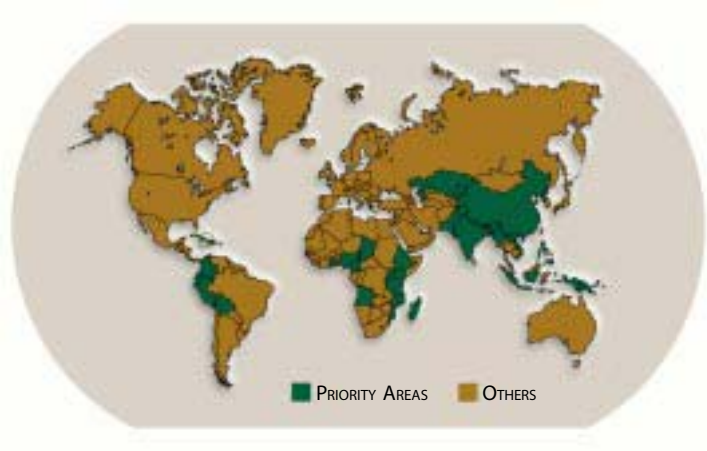
1 This is not an exhaustive list of where impacts of CIP-related technologies have occurred. Rather, these are selected cases where CIP has been able to conduct formal benefit–cost analysis of technologies known to have been widely adopted. It is part of an ongoing effort to assess and document impacts of CIP in developing countries.

2 Net present value estimated using a 10% discount rate. Poverty content is the estimated share of total benefits going to poor households (based on the percentage of the population in impacted areas living below $1/day). Benefits of technology adoption are projected into the future based on estimates of the probable adoption patterns and "life span" of the technology. See Walker TS and Fuglie KO, 2000. Impact Assessment at the International Potato Center (CIP) in the 1990s. Paper presented at the CGIAR Impact Assessment Workshop, 3–5 May 2000, FAO, Rome, and the papers cited therein for more detailed results and sensitivity analysis of the estimated rates of return to research investments.

In the early 1990s, CIP began evaluating the impact of its technology. The studies, conducted by economist Thomas Walker and teams of national and international cooperators, showed that the benefits associated with CIP research exceeded US$650 million. According to Walker's estimates, total benefits began to surpass donor investments in 1987, a process that accelerated throughout the 1990s. Current net benefits, which are summarized above, are estimated at US$155 million per year.

Targets for CIP Vision

As part of the recent CIP Vision exercise, the Center's systems analysts superimposed potato and sweetpotato crop production statistics with data on poverty, malnutrition, and child and maternal mortality to help pinpoint the locations where CIP's research is most likely to help the poor. The resulting map targets eight regions and provides compelling evidence that research investments in West Africa should be given high priority.



Fuglie notes, however, that previous CIP priority-setting exercises had important limitations. Center researchers acknowledge, for example, that CIP's priority setting has historically been somewhat one-dimensional, with targets selected principally on the basis of expected varietal adoption and the resulting crop production value.

Disaggregating the data

"What happened in past planning exercises," adds Pamela Anderson, CIP's Deputy Director General for Research, "is that our priority setting was based on global aggregate data. We didn't have the mapping and modeling tools we have now to disaggregate the data, let alone pinpoint the locations where it makes the most sense to focus on a particular type of research."

Anderson notes that in CIP's 2003 visioning exercise, geographic information systems and a special algorithm developed by the Center's systems analysts were used to overlay World Bank and FAO data with on-the-ground information provided by CIP regional scientists and national cooperators. The study compared four poverty indicators: income (under US$1 a day), child and maternal mortality rates, and persistent hunger.

The end product was a poverty map (see above) that has been overlaid with CIP's crop maps to show where the Center's research is

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CIP scientist receives 2003 Derek Tribe Award

CIP virologist Luis Salazar received Australia's 2003 Derek Tribe Award for research that led to major increases in sweetpotato production in three Chinese provinces. China, the world's largest sweetpotato producer, was the first country to benefit from advanced technology that eliminates virus diseases from farmers' planting materials. Use of the technique, economists say, led to a 7 percent increase in world sweetpotato supplies and added some US$550 million to the Chinese economy.

"Dr. Salazar developed the detection technology needed to make the system work," says CIP Director General Hubert Zandstra. "It was Lucho's research that made the process feasible, and China's determination and organizational skills that made it work on such a large scale."

Salazar, a Peruvian national, joined CIP in 1973. Before that, he was a member of the team that adapted the ELISA technique for virus detection in plants. ELISA is a standard tool of clinical immunology and is commonly used to screen for HIV and other viruses in humans.

"Derek Tribe was a great friend of CIP, and China is one of our oldest and most important partners," Zandstra adds.

The Derek Tribe Award was established in 2001 in recognition of Professor Tribe's contributions to international agricultural research. Sponsored by the Crawford Fund, it is presented biennially to a citizen of a developing country. This is one of the many activities undertaken by the Crawford Fund to raise awareness about the links between food, environment, and the world's poor. The Fund also assists in the transfer of agricultural technologies to developing countries. It was established by the Australian Academy of Technological Sciences and Engineering in honor of the late Sir John Crawford, one of the founders of the CGIAR and one of CIP's early champions.

The award was presented to Salazar by the Honorable Tim Fischer, Chairman of the Crawford Fund, at a ceremony in Canberra, Australia on December 4, 2003.

likely to do the most good. The map, Anderson says, will be the principal working tool of the Center's Impact Enhancement Division, one of six new research divisions specially designed to contribute to the United Nations Millennium Development Goals.

The Impact Enhancement Division's long-term objectives are to increase the effectiveness of the Center's targeting tools, to monitor the impact of CIP research as it evolves, and to set mid-course corrections. Staff assigned to the Division will continue to focus on identifying priority geographical areas, populations, and systems. Thus far, 33 countries in eight regions have been targeted in this way, though Center researchers acknowledge that more work is needed to filter down to specific locations.

While many of the sites identified are already hosting ongoing CIP research activities, initial analyses also indicate the existence of pressing needs and new opportunities in areas such as West Africa, where the Center has not worked since the early 1990s.

Built-in safeguards

Anderson notes that once the Division's first set of targeting exercises is complete, most likely before the end of 2004, the Center's social science team will conduct participatory needs and opportunity assessments to determine the types of knowledge and technology that will most quickly achieve results in each location.

"Safeguards are being built into the Division's procedures and policies to avoid missteps that might adversely affect the poor or damage the environment," Anderson acknowledges. "The unintended consequences of new technology can easily have negative consequences for farm families already at high risk," she explains.

CIP Director General Hubert Zandstra adds: "Scientists don't like to be taken away from their research, but this was an exercise that needed to be done and it is already providing benefits." The Center's visioning and priority-setting exercise, he notes, has met with support from a range of partners and donors.

World Food Prize winner Pedro Sanchez, in a statement to the participants attending the CGIAR 2003 Annual General Meeting in Nairobi, stated that: "CIP has taken leadership in assessing and realigning its program to meet the Millennium Development Goals, setting an example that can be followed by other(s)." Sanchez, together with M. S. Swaminathan, is Coordinator of the UN Millennium Development Project Task Force on Hunger.

Advanced technologies readied for potato and sweetpotato producers

In an effort to serve the poorest and most vulnerable members of society, CIP scientists—working side by side with researchers in Africa and Latin America—are pairing genetic diversity with the tools of modern molecular biology to provide solutions to a series of long-standing problems

Public sector donors and private foundations have provided support for new initiatives that should set the stage for a dramatic reduction in the use of agro-chemicals and provide increased market access for smallholder potato and sweetpotato farmers.

After nearly a decade of research, for example, CIP and African scientists recently concluded that the development of a transgenic sweetpotato may be the only way to control one of Africa's major crop pests: the sweetpotato weevil. Despite concerted efforts over a ten-year period, scientists have been unable to identify sources of genetic resistance or develop integrated pest management practices that provide even minimal control.

Weevils pose a significant burden to Africa's sweetpotato farmers. Production losses can easily reach 60 percent because even slightly damaged roots are unfit for the market or for human consumption. The impact of such losses is particularly devastating in Eastern and Central Africa where sweetpotato is grown mainly for household subsistence.

"Our intention is to incorporate into sweetpotato a gene derived from a bacteria that acts as a natural pesticide," says Marc Ghislain, head of CIP's Applied

Biotechnology Laboratory in Lima. Known as Bt, or *Bacillus thuringensis,* the bacteria is widely used as a bio-insecticide by organic farmers. Crops containing Bt genes are the second most widely grown transgenic plants, and most importantly, they are considered safe for human consumption.

"At least that's the consensus within the scientific community," Ghislain says, "although critics of transgenic crops may still choose to challenge that view." A recent report from Africa's leading potato and sweetpotato research network, PRAPACE, acknowledges the advantages of the Bt sweetpotato. PRAPACE is the French acronym for the Regional Potato and Sweetpotato Improvement Network in Eastern and Central Africa.

"Frankly, we have little choice but to use Bt," Ghislain says. "There appears to be no other way to control weevils. If there were a better way to achieve the same result, we would certainly pursue it."

Because the types of weevils that attack African sweetpotatoes are not present in South America, where CIP's biotech team is located, the research will be conducted in the United States and in Uganda. The initiative, budgeted at US$850,000 over three years, is expected to start up in 2004.

CONSUMER-FRIENDLY GENES

Ghislain notes that the project will be the first to make use of a new technology that should reduce consumer concerns about the safety of bio-engineered food crops. Developed at CIP with support from the Rockefeller Foundation, the technology involves the use of a tobacco gene as a "selectable marker," which provides the vehicle for transformation, instead of the antibiotic resistance markers usually used in genetic engineering. Although extensive studies have demonstrated that antibiotic resistance genes are not a threat to human health, consumer concerns persist. The new selectable marker provides a means of reducing these fears.

To address other important biosafety concerns, researchers plan to insert the Bt genes into easily distinguished, non-flowering varieties of sweetpotato. The use of such easy-to-identify plants should help farmers to recognize the transformed varieties, while the fact that the plants do not flower will prevent the movement of the Bt gene to other sweetpotato varieties and weeds. In addition, scientists from Uganda's National Agricultural Research Organization will screen all the transformed plants in special facilities to ensure full confinement. The best-performing lines will be field-tested as soon as national biosafety regulations are in place.

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A VIRTUAL POTATO HERBARIUM IS ONE OF THE INNOVATIONS INTRODUCED BY CIP RESEARCHERS TO HELP DOCUMENT AND UNDERSTAND BIODIVERSITY.

Tracking the past, charting the future

CIP scientists worked throughout much of 2003 to complete the first major components of the Center's electronic germplasm acquisition, tracking, and distribution system. The system, which charts germplasm movements back to the 1970s, was designed in part to help the Center fulfill its obligations under the International Convention on Biological Diversity. It was assembled from some 20 independent databases and from old paper archives, and includes information on the origin and distribution of thousands of genetic samples and herbarium specimens.

"It's taken us almost five years to build a computerized platform that integrates information going back nearly three decades," says CIP Plant Breeder Enrique Chujoy. "It is now possible to determine, with a high degree of certainty, what materials a cooperator has received, where there are gaps, and what we can do about it."

The system was recently used, for example, to evaluate all of the germplasm sent to Ethiopia over a 25-year period. The results indicated that the 1,453 potato breeding materials sent to Ethiopian cooperators are a cross section of older CIP breeding lines whose resistance to late blight disease has since proven to lack durability. Accordingly, Center scientists are now shipping to Ethiopian partner agencies hybrids that provide longer-lasting resistance and earlier harvests (see *Harnessing the Trend: A Millennium Strategy for Africa*, page 57). Ethiopia was identified by the Center's visioning exercise as a key target for future cooperation.

One of the system's most important features will be an electronic catalog of CIP advanced breeding lines. The catalog, which will be brought on-line in 2004, provides photographs of all available materials, as well as data on how they are likely to perform under specific conditions. Until now, cooperators who requested CIP breeding materials were asked to first provide information on local conditions. This information was then evaluated by CIP scientists, who would then provide the materials they considered best adapted to the environment in question.

"Now," says Chujoy, "anyone with a computer and Internet access will be able to request the genetic material they think is best suited to their local conditions." In addition, cooperators will be able to see where a specific accession originated and where it has been sent. The system should be accessible to the public by the end of 2004.

Biosafety regulations for Africa's transgenic sweetpotatoes

By 2009, African scientists and CIP researchers plan to deploy genetically engineered sweetpotatoes to address two priority productions problems: weevil infestation and virus diseases.

Although the new plant types will offer substantial benefits in the form of food security and family income, lack of knowledge about how foreign genes (also known as transgenes) will combine with traditional farmer varieties could present important obstacles.

"It is highly probable that genes from genetically engineered sweetpotatoes will eventually spread to Africa's traditional varieties unless steps are taken to establish regulatory and monitoring procedures," says Dapeng Zhang, a former CIP sweetpotato breeder now with the United States Department of Agriculture.

The spread of transgenes could be higher in Africa than in other parts of the world because the continent's sweetpotato fields tend to be small and are planted in close proximity, and because of the absence of formal seed systems, which register varieties and monitor their use. The fact that farmers mix sweetpotatoes with secondary crops, grow many different varieties, and save their planting material for the following year's crop further complicates the problem.

Marc Ghislain, head of CIP's Applied Biotechnology Laboratory in Lima, and colleagues are developing plans to characterize Africa's sweetpotato cropping systems and assess sweetpotato pollination mechanisms. By developing knowledge on the reproductive biology of African sweetpotato varieties, they plan to help national regulatory agencies to develop policies and procedures that will allow them to safely introduce transgenic varieties.

Zhang and Ghislain both emphasize that while biosafety procedures for crops grown from conventional seeds—such as corn or wheat—are well established, most of these are not relevant for crops such as sweetpotato, which are vegetatively propagated in subsistence farming systems.

"Regulations are needed to ensure that genetically engineered (GE) and non-GE varieties can exist side by side," Ghislain says. "The only way to do that is to have the technology and the policies in place that will allow for effective segregation."

Ghislain also recommends the adaptation of methods for risk assessment and the establishment of monitoring systems to evaluate the long-term impact of transgenic sweetpotatoes on the environment and on farmers' conservation of agro-biodiversity.

"CIP's role in the project will be largely advisory," Ghislain adds. "Our contribution will be to provide scientific expertise, increase local capacity through training, and serve as a facilitator between patent-holders, regulatory agencies, researchers, and civil-society." It is expected that the International Service for the Acquisition of Agri-biotech Application's (ISAAA) Africenter for technology transfer will also participate in the project, as will the CABI Uganda Biotechnology Initiative, the UNEP Biosafety Project, ASARECA (the Association for Strengthening Agricultural Research in Eastern and Central Africa), and the Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA), an ASARECA network that promotes regional economic growth through the application of growth-enhancing agricultural policies.

New opportunities for Andean potato farmers

In South America, meanwhile, broad-based international partnership will play a role in a project that will provide farmers with high-value, low-input disease-resistant potato varieties. With help from the German Ministry for Technical Cooperation (GTZ) Germany, and building on past investments made by the European Union, CIP scientists are now working with partners in five countries to use a pool of newly developed potato hybrids that carry broad-spectrum disease resistance derived from genes found in wild Andean potatoes.

The new varieties—which incorporate resistance to late blight disease and Potato Virus Y, both of which are priority problems in the high Andes—are expected to begin reaching farmers within three years.

"The estimated impact of the new varieties is considerable," says Plant Breeder Merideth

The tools of molecular biology can help to produce new crops, offering urgently needed solutions to a problem that plagues African farmers: the sweetpotato weevil.

Bonierbale. "They should benefit at least 200,000 Andean farm families before 2009." Bonierbale is the Head of CIP's new Germplasm Enhancement and Crop Improvement Division.

An important feature of the project, Bonierbale notes, is that it will include extensive DNA characterization and identification of disease-resistant accessions in national and international genebanks. The data derived from this research will be incorporated into databases, helping partners to speed up their use of resistant wild species in breeding programs.

The project will also use genetic maps to identify complementary sections of potato chromosomes that can be "pieced together," thereby building genetic combinations that will provide long-lasting resistance in farmer- and consumer-preferred crops. "Our intention is to adapt modern molecular tools to the needs of national breeding programs as quickly as possible," says Christiane Gebhardt of the Max Planck Institute for Plant Breeding Research (MPIZ) in Cologne, Germany. MPIZ is a long-time CIP collaborator.

Bonierbale and Gebhardt anticipate that project activities, which range from molecular genetics to participatory variety selection, will reduce the time required to test and release improved potatoes by at least five years.

"The project will rely on social scientists to organize focus groups that will identify farmer and consumer preferences for potato varieties," Bonierbale notes. Economists will also evaluate potential benefits of the new varieties in terms of household economics, human health, and the environment. Some of the benefits expected, in addition to higher profits, are reduced fungicide use, improved market acceptance, and stabilized prices.

The first group of potatoes to emerge from the project is expected to cover approximately 60,000 hectares, an area equivalent to about 10 percent of the combined potato growing areas of Bolivia, Colombia, Ecuador, and Peru. Roughly 50,000 to 75,000 farm families should benefit in this initial stage.

Project partners, in addition to MPIZ and CIP, include Bolivia's *Fundación PROINPA,* Colombia's *Universidad Nacional*, Ecuador's *Instituto Nacional de Investigaciones Agropecuarias*, Peru's *Instituto de Biotecnología de la Universidad Nacional Agraria La Molina*, and Germany's University of Tübingen.

CIP SCIENTISTS SET TO BREACH AGE-OLD DISEASE BARRIER

IN WHAT APPEARS TO BE A MAJOR ADVANCE IN THE FIGHT AGAINST BACTERIAL WILT DISEASE, CIP PATHOLOGISTS REPORTED IN 2003 THE LIKELIHOOD THAT HIGH LEVELS OF DISEASE RESISTANCE CAN BE FOUND IN A SMALL GROUP OF WILD POTATO SPECIES

The identification of a potential source of resistance to bacterial wilt builds on more than 30 years of genetic conservation and plant pathology research, representing an important piece in a puzzle that has escaped solution by generations of scientists and the farmers that they serve.

Bacterial wilt, which is second only to late blight in its impact on developing country potato production, affects millions of farm families in more than 40 developing countries. "The disease is not just a production problem; it has a profound effect on the environment and on poverty," says CIP Director General Hubert Zandstra. "By providing farmers with new technological options, anchored by resistant varieties, we hope to create a platform that will benefit not only producers, but society at large."

The search to identify sources of resistance, Zandstra notes, was given new impetus in the late 1990s by the development of a highly accurate screening technique that allows researchers to detect latent forms of the disease. Armed with the new procedure, CIP plant pathologists spent nearly three years screening thousands of wild and cultivated plants for resistance. "We have good indications that their search was successful and that resistance will be confirmed in a third and final screening to be conducted during the second half of 2004," Zandstra says.

In Huanuco, Peru, farmers participating in field schools have learned to diagnose bacterial wilt accurately and to use control measures—such as removing wilted plants and spreading ash or chalk in their place—that help them to prevent disease dissemination in their fields.

Many of the wild species screened in 2003 for bacterial wilt resistance were first observed by CIP Plant Taxonomist Alberto Salas growing in locations where potato farmers experience severe losses from the disease. "Salas' observations," says plant pathologist Sylvie Priou, "provided the first indication that resistance might exist in nature."

The pathogen that causes bacterial wilt, *Ralstonia solanacearum*, is spread principally through infected seed stocks. Because disease symptoms are invisible in cool climates, where most potato seed is produced, even seed tubers that appear to be healthy can carry the disease pathogen. To control bacterial wilt, farmers have only two options: to purchase costly certified seed, or to eliminate the pathogen in their fields using crop rotations and other sanitation measures.

In 2000, CIP economists estimated that the availability of a potato with bacterial wilt resistance would increase productivity an average of 10 percent across the developing world. Overall benefits were calculated at US$125 million per year, with the greatest impact in countries such as China, Bangladesh, Bolivia, and Uganda.

Hope from the wild

To come up with these promising results, CIP scientists subjected more than 3,900 genotypes of potatoes from 111 wild species and subspecies to two series of greenhouse tests. The plants were exposed to a mixture of aggressive disease variants in a simulated tropical environment that combined high temperatures and humidity.

A third series of tests will screen for the presence of the pathogen in its latent form in tubers derived from inoculated plants. The tests, which are believed to be the first of their kind to be conducted, will help to identify resistance in both the plant and its tubers.

In the first series of tests, resistance to all variants of the pathogen was identified in four genotypes from the species *Solanum acaule*. The search for additional sources of resistance will continue, however, throughout 2004 as six promising, but rare wild species become available for testing.

Officials at the Conservation, Food, and Health Foundation (CFH), a US Philanthropy that provided funding for the research, note that CIP's bacterial

wilt project demonstrates how private philanthropy can set the stage for important scientific partnerships.

"Our expectation was that by investing in the research we could stimulate larger contributions by public sector donors, who would become interested once Center scientists had demonstrated that resistance did indeed exist in nature," explains Prentice Zinn, a CFH project officer. "Now that the research is close to completion, we hope that they will support the next phase of trials." Two other philanthropies, the Wallace Genetic Foundation and the International Foundation, also provided funding for the project.

Sylvie Priou, who heads up CIP's bacterial wilt research team, notes that because the sources of resistance identified thus far are derived from wild relatives of the domesticated potato, it should be relatively straightforward to move resistance genes into commercial potatoes, either through conventional breeding or genetic transformation. "The end product would essentially be the same," she says, "but a breeding program that uses non-adapted wild germplasm could take 15 to 20 years, while direct gene transfer might produce equivalent results in about half the time."

Multiple strategies

Meanwhile, CIP scientists continue to work on and disseminate other control strategies, including moderately resistant varieties, pathogen detection, biological control, and management practices that help farmers eliminate the pathogen from their fields.

"Right now the most effective way to prevent bacterial wilt," Priou says, "is to detect the pathogen on seed before it reaches farmers' fields."

Industrialized countries, which also suffer from bacterial wilt, routinely screen large amounts of seed tubers using sophisticated detection techniques that are effective, but expensive. The CIP-developed detection kits are equally sensitive and are far more appropriate to developing country conditions. At a cost of approximately US$100, each kit can be used to evaluate up to 300 tons of tubers, enough seed to plant 150 to 200 hectares. CIP has also developed ultra-sensitive kits that allow researchers to detect very low populations of the pathogen in the soil.

There is one drawback: CIP's kits, now in use in 13 countries, can only reduce seed infection rates if used in conjunction with an organized seed system. Such systems, which eliminate infected seed before it reaches farmers fields, unfortunately, are rare in developing countries.

While CIP continues to lend support for seed system development in its partner countries, the Center is backing farmers up by providing immediate, albeit limited, defense against bacterial wilt in the form of a new series of 15 disease-tolerant potatoes, which will begin shipping in 2004.

To achieve sustainable yields using the tolerant varieties, farmers will need to periodically renew their supplies of disease-free seed and use measures—such as crop rotation—to eliminate the pathogen from their soils.

Although rotational systems are an ancient Andean tradition, in recent times crop rotations have been severely reduced because of the pressure on the land resulting from population growth. Abandoning potato production for the four to five years needed to deprive the bacterial wilt pathogen of its food source is an unattractive option, especially if one takes into account the importance of this crop for the burgeoning Andean population. New cultural practices and control components developed by farmer-researcher groups in Peru and Bolivia are changing this picture. With funding from the United Kingdom's Department for International Development (DFID), researchers have identified simple rotations that will allow farmers to sanitize their soil while planting potatoes more frequently.

A recent example came from Peruvian and Bolivian participants in farmer field schools. Working in highly infested fields, they succeeded in sanitizing their soils by following potatoes with two successive crops of cabbage, onions, sweetpotatoes, or arracacha. (Arracacha, an Andean root crop, is a relative of carrot and is frequently used to produce high quality baby food or as a starchy dessert.) The experiment was so successful that the farmers were replanting potatoes within 18 months. The results of the trials were subsequently confirmed using CIP-developed testing kits.

These hands-on solutions should help farmers to keep bacterial wilt at bay. Priou notes that researchers continue to search for other crops with good market potential that can be used to further reduce rotation times while increasing family incomes, thereby ensuring greater food security for people living in marginal environments. Combined with other common-sense management practices, such as removing volunteer potato plants and weeds, the techniques provide farmers an affordable way of coping with a difficult problem.

Spreading the word

"Our bacterial wilt management program is not sophisticated science, but it is practical and can

Sylvie Priou and Alberto Salas examine potato plants in a CIP greenhouse.

Biocontrol of bacterial wilt

In laboratory and greenhouse tests conducted in 2003, CIP scientists identified several naturally occurring bio-agents that appear to prevent the bacterial wilt pathogen from attacking tomato, a relative of potato that is extremely susceptible to the disease. The control agents include the bacteria *Pseudomonas putida* and *Burkholderia cepacia,* both of which significantly diminished disease symptoms and reduced latent infection. The results, while highly promising, require additional study and experimentation. First the bacteria must be proven effective with potatoes. Then researchers will have to test their effectiveness in farmers' fields, and ensure that they are economically viable and easy to use.

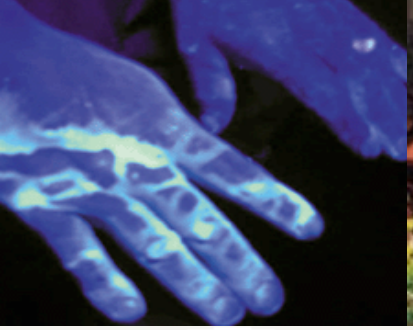
make a difference to poor people who depend on potatoes for food and income," Priou says. She notes that participating farmers are eager to adopt the new methods and that many of the participants are now teaching people in neighboring communities to use them.

"It's not uncommon for highland farmers to share their expertise. It's part of their tradition, but it also makes sense. What happens in one community affects those who live nearby. The pathogen that causes bacterial wilt can easily spread from field to field on farmers' shoes and tools, or even in irrigation water," she says.

Farmer field schools, based on discovery learning, are ideal vehicles for spreading these innovations. "The field school concept helps farmers to understand the entire disease and crop production cycle and unravel large parts of a complicated puzzle. Once they understand what's going on, they're usually willing to adopt various management options and to experiment with new ones," Priou says. Among these are seemingly unusual practices such as sanitizing the soil at planting time by applying bleach, chalk, disease-free barnyard manure, or even ashes from cooking fires.

"Most importantly," she adds, "we researchers are learning how to leverage farmers' knowledge not only so it helps others, but so that it provides feedback on the relevance of our research." Priou notes that a number of studies to confirm the effectiveness of traditional farmer methods for controlling the disease are currently underway.

CIP's bacterial wilt farmer field school project was conducted in partnership with national programs in Bolivia and Peru; and with community development groups, nongovernmental organizations, national crop protection agencies, and PROINPA, a private research and development foundation in Bolivia. Lessons learned from the initiative are currently being compiled in a user-friendly field guide and should be available before the end of 2004.



New research division integrates crops, environment, and human health

CIP's new Agriculture and Human Health Division, which will be fully operational by the end of 2004, is expected to play an especially important role in the Center's efforts to help reduce infant and maternal mortality and improve the lives of the urban poor

In 2003 CIP became the first CGIAR center to create a research division that fully integrates crop and natural resource management research with human health. By merging a variety of on-going research projects, and by complementing the Center's traditional strengths in agriculture and natural resources, the division is expected to make important contributions to the health and well-being of millions of people who depend upon root and tuber crops for food and income.

"CIP is consolidating a research agenda that merges health, environment, and productivity research into a unified package," says Pamela Anderson, CIP's Deputy Director General for Research. "The Center has done important work to improve human health, but, as in many other CGIAR centers, our projects have been somewhat scattered." Establishment of the new Division, Anderson notes, is driven by CIP's alignment with the UN Millennium Development Goals and takes its impetus from recent resolve on the part of various CIP partners to target child and maternal mortality in their national development plans. Tanzania and Kenya, for example, have announced plans to reduce child mortality by two-thirds before 2015.

Next step: Implementation

The decision to create the new division was made following CIP's 2003 visioning exercise and consultations with international experts in the fields of public health,

Fluorescent tracers help researchers to evidence pesticide residues on the bodies of applicators, as well as non-workers—including children.

ECOSALUD:
Environment and health

As CIP scientists sharpen their focus on child and maternal health, they will be guided by the experience gathered in a pilot program conducted in Ecuador in the 1990s. The ECOSALUD project, whose name was derived from the Spanish words for environment and health, provided documentary evidence of the negative human health impacts of pesticides used on potatoes.

CIP researchers and their national and international partners working in the El Carchi area of Ecuador—the country's northernmost province—found that two-thirds of all potato farmers in the province suffered serious, long-term neurological damage from their exposure to pesticides.

"Through ECOSALUD we discovered that the number of pesticide poisonings was ten times higher than first believed," says economist David Yanggen. "We also learned that pesticide-related illnesses were the Province's second leading cause of death, just after traffic accidents." El Carchi, Yanggen notes, has one of the highest recorded incidences of pesticide fatalities in the world.

ECOSALUD was an early proponent of combining environmental research with studies of human health, and one of the first to link these concerns to practical solutions that benefit farmers and their families. Through ECOSALUD's farmer field schools, potato producers have learned how to control pests using resistant varieties, insect traps, and other management practices while protecting—and improving—their profits.

The project is now in its second phase thanks to continued funding from Canada's International Development Research Centre (IDRC).

toxicology, and nutrition. Next steps will include the creation of a task force, made up of Center scientists and external experts, to develop an implementation plan. The plan, slated for completion in 2004, is expected to have pesticide reduction in potato and sweetpotato cropping systems as one of its principal targets. This will build on CIP's strong track record in integrated disease and pest management, which has already led to significant reductions in the use of agro-chemicals.

Anderson, who holds degrees in both entomology and public health, believes, nonetheless, that past efforts to cut pesticide abuse—by CIP and others—have rested largely on economic and environmental arguments. CIP plans to incorporate human health and safety criteria, and expects that these may have a major effect on research formulation, targeting, and effectiveness. "By incorporating the health perspective," she says, "we not only bring into play more powerful arguments for using integrated pest management. We also increase the likelihood of technology adoption by demonstrating opportunities for reducing risks to farm workers and increasing the safety of our food supplies."

Expensive plant breeding programs, Anderson notes, are easily overturned by lack of consumer confidence in new technology or by government concerns about safeguarding their countries' export markets. The new division will address these roadblocks through a variety of food safety and biotechnology initiatives, including a new Rockefeller Foundation-funded project to remove antibiotic markers from transgenic crops (see *Advanced Technologies Readied for Potato and Sweetpotato Producers*, page 21).

CIP's work in food-based solutions to nutrient deficiency—already well advanced through research with high beta-carotene, orange-fleshed sweetpotatoes to combat vitamin A deficiency in Africa—will form another central component of the Division's work plan (see *Study Shows Effectiveness of Orange-fleshed Sweetpotatoes*, page 36). "One of the lessons that we've learned from the Vitamin A for Africa program is that there are major benefits to be had from partnerships with colleagues working in the food and health arenas. To realize those benefits in time to meet the UN Millennium Goals, however, we need to have staff on board who can complement the Center's traditional strengths in agriculture and natural resources," Anderson says. For this reason, CIP will post a division coordinator with expertise in tropical public health and experience in nutrition and toxicology at Center headquarters.

Study shows effectiveness of orange-fleshed sweetpotatoes

South African scientists working under the umbrella of the Vitamin A for Africa partnership (VITAA) have completed what is believed to be the first controlled study to establish the value of orange-fleshed sweetpotatoes in combating one of Africa's most important public health problems: vitamin A deficiency in young children.

The study, which involved primary school students between five and ten years of age, showed that over a period of just eleven weeks, the proportion of children with adequate vitamin A liver stores increased 10 percent among those who ate high beta-carotene orange-fleshed sweetpotatoes. A comparable group that ate only white-fleshed sweetpotato experienced a 5 percent decline.

"This first-of-its-kind study was approved by the Ethics Committee of the South African Medical Research Council and was conducted with the agreement of local authorities and parents," says nutritionist Penny Nestel. Dr. Nestel, who currently acts as Nutrition Coordinator to the CGIAR HarvestPlus program, previously served as a senior advisor to the VITAA initiative. VITAA contributes important experience to HarvestPlus with its success in using food-based solutions to combat micronutrient deficiency.

According to Nestel, the bio-efficacy study was made possible through the cooperation of partners from many different sectors. "One of the unique things about VITAA is that it brings together professionals from the health, nutrition, and agriculture sectors. The partners include seven African countries, among them South Africa's Agricultural Research Council, which supplied the sweetpotatoes used to complete the study."

Major financing for the study was provided by the Micronutrient Initiative, which supports and promotes food fortification and supplementation programs throughout the developing world. Complementary funding was made available by the Health Office of the United States Agency for International Development (USAID), which provided resources for measuring the vitamin A status of the children and the retention of ß-carotene in cooked sweetpotatoes.

Sweetpotato fermentation process aids Papuan pig farmers

A CIP-developed processing technique that helps farmers turn sweetpotato into nutritious pig feed—without cooking—is expected to benefit farmers and consumers throughout Indonesia's Papua province and eventually spread to neighboring Papua New Guinea.

Pioneered in Vietnam in the late 1990s by former CIP researcher Dai Peters[1], fermentation of sweetpotato to produce feed cuts the time needed to fatten pigs for market by up to two-thirds. The practice, which continues to gain wide acceptance in Vietnam, involves mixing sweetpotato roots and vines with other additives before allowing the mixture to ferment. This is a departure from the traditional method of producing feed from sweetpotatoes, which involves time-consuming chopping and boiling.

Aside from relieving women of a considerable burden, the fermentation method is popular because it reduces firewood consumption and because the processed roots can be kept for months without special storage facilities. It also boosts household income by increasing the efficiency of farm and family resources, and by increasing the number of pigs that can be raised in a given year.

The project, now in its second phase, is financed by an A$1.2 million (US$940,000) grant from the Australian Centre for International Agricultural Research (ACIAR). Key collaborators include the Indonesian Research Institute for Legumes and Tuber Crops (RILET), Papua's Jayawijaya District Livestock Office, and the South Australian Research Development Institute (SARDI).

Diversity at the core

Papua, formerly known as Irian Jaya, occupies the western half of the island of New Guinea and covers an area nearly twice the size of the Netherlands. The region is also

Sukendra Mahalaya, project assistant in the CIP-Bogor office, and Luther Kosay work together on the CIP-ACIAR project to ensure that sweetpotato will continue to improve lives for people in Papua. At left, Kosay examines an unusual sweetpotato from project experiment fields (middle). Below, Kosay and Mahalaya confer on project issues.

home to some of the world's most unusual sweetpotatoes.

"The traditional varieties grown in Papua don't always resemble what we think of as sweetpotato," says Keith Fuglie, CIP Regional Representative for East and Southeast Asia and the Pacific. Fuglie, who is based at the CIP office in Bogor, notes that local farmer varieties come in unusual shapes and colors, and serve a variety of uses. Some are used for food, some are grown for pig feed, and others are used specifically for ceremonial or religious purposes.

Through natural and farmer selection, New Guinea's sweetpotatoes have evolved into unique local varieties that thrive in isolated ecological niches. In some cases, the island's sweetpotatoes can be found growing at 2,800 meters above sea level, considerably higher than those found in South America. In the central highland Baliem Valley, where the project activities are located, at least 1,000 types of sweetpotato are cultivated by farmers and a single field may contain between 20 and 40 distinct varieties.

"We're conscious of our responsibility to safeguard biodiversity as we introduce improved varieties," says Fuglie. Farmers are involved early in the evaluation process and are encouraged to incorporate promising new varieties into their production systems to complement, but not replace, existing varieties.

Local varieties and farming systems, Fuglie notes, underwent meticulous study before the introduction of new varieties began. In the early 1990s, CIP led a 10-year project with funding from the Swiss Agency for Development and Cooperation (SDC) to conserve and characterize native "landraces" of sweetpotato. Over 500 varieties were collected and studied, and CIP helped to establish an *in situ* conservation site in Papua. For safekeeping, the Center maintains a duplicate collection at an Indonesian research station in Java.

Luther Kosay: A tale of two worlds

Project researchers also pay special attention to the farming and social structures in New Guinea to avoid working against the grain of local practices and principles, many of which are poorly understood by outsiders. In this regard, the cooperation of locals such as Luther Kosay, a member of the Hubura tribe in the highlands of the Papua province, has played a major role in the initiative's success.

Since November 2001, Kosay has coordinated the CIP-ACIAR project's on-station and field research. In the course of an ordinary day, Kosay manages an array of complicated field trials, collects socioeconomic data, and serves as the link between farmers and scientists working in the pig feed project.

"Luther is invaluable," says Fuglie. "He is our principal liaison between project scientists and local farmers and is an outstanding technician as well." Kosay's contribution to the project, nonetheless, goes far beyond this important role. He has provided important information on the Papuan sociocultural and belief systems associated with sweetpotato and pig raising. "Without his help we would be working with little knowledge of local customs and almost no ability to communicate with local people," adds Fuglie.

Rural sociologist Dai Peters conducted extensive interviews with Kosay and recorded his experience and insights. "Luther was born Idoakoba Kossy of the Witawaya clan of the Hubura tribe," notes Peters. Although Kosay did not know the date of his birth, he was certain that he was born sometime before 1962, when Indonesia obtained sovereignty over the region and began registering births. "He stated with precision: *I must be between 40 and 50 years old*," adds Peters.

"The changes Luther underwent in his life parallel the change of the Hubura in general," notes Peters. "Their macro changes can be vividly

understood by way of the micro changes that he underwent." According to Kosay, although diets have become more diversified in recent years, sweetpotato remains central to the tradition of the Hubura people, or Dani, as they are now called. Not only are the roots appreciated as food; sweetpotatoes are also fundamental to local pig production, and pigs are at the core of Dani social, cultural, and economic values.

Kosay's knowledge comes from firsthand experience. Until entering primary school, sometime between the age of 15 and 20, he spent most of his time caring for his family's pigs as they roamed the forests in search of food. Sweetpotato was fed to the pigs twice a week, meaning that considerable time and energy was spent finding and transporting the firewood needed to cook enough roots for dozens of pigs.

Because he did not know how to count, comments Peters, Kosay kept track of his pigs by repeating to himself: "I have a brown pig, a black one, a white one, and a black and white one; and I have two pigs with ears cut." He told time by observing the shadow cast by the sun. Exposure to mission schools changed this. It also changed Kosay's name—and the course of his life, which included 14 years as a primary school teacher before joining CIP.

LIFE-SIM 2003, a simulation model developed in the high Andes, is helping Asian nutritionists and animal scientists to improve their livestock systems.

CIP modeling tools assist Asian livestock producers

CIP scientists are collaborating with Asian researchers to predict the impact of feeding sweetpotato roots and vines to millions of pigs. The research, which is conducted under the banner of the Systemwide Livestock Initiative, convened by the International Livestock Research Institute (ILRI), should help local pork producers cope with rising feed prices.

At a workshop held in August 2003, 26 nutritionists and animal scientists from five Asian countries received training in the application of the LIFE-SIM 2003 simulation model, a tool that can help researchers predict responses to changes in livestock feed strategies. The model was originally developed by CIP for natural resource management research in the high Andes. A specially adapted version for Asian livestock systems includes two new tools: a simulation model for pigs and milking buffaloes, and a revised version for dairy and beef cattle. The models are freely available and can be downloaded from the CIP website.

As Asia's people become wealthier, meat consumption is expected to grow, potentially forcing farmers to purchase grain at higher prices. An article published in the *China Daily* in October 2003 noted, for example, that corn supplies throughout China were extremely tight and that prices had jumped more than 7 percent in one major swine-producing province.

The workshop was held at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), a long-time CIP collaborator. It was organized by the Crop-Animal Systems Research Network (CASREN), which is supported by ILRI and is financed by the Asian Development Bank (ADB).

For more information about CIP modeling work in Asia, read *New Tools Simplify Decision Making In Complex Mountain Ecosystems* in CIP Annual Report 2002.

"Through people like Luther Kosay, and with help from ACIAR, CIP hopes to boost the efficiency of a traditional crop in a way that complements local traditions and increases people's ability to compete in a rapidly changing society," concludes Fuglie.

Security for the future

Introduction of the sweetpotato fermentation technology comes at a particularly important time as Papua undergoes rapid population growth. By some estimates, the province will double its population by 2010.

The project will help to offset food shortages and malnutrition, problems that are prevalent throughout the highlands of New Guinea, especially in isolated communities such as those in the Baliem Valley. In 1997-98, for instance, famine was reported after an especially severe drought associated with the El Niño phenomenon.

According to Colin Cargill, a SARDI animal scientist who is leading the second phase of the project, the initiative is not focused solely on sweetpotato fermentation, but also works to promote better management practices, reduce animal diseases and parasites, and provide training to community leaders and extension agents.

Thus far some 300 farmers, as well as staff from the Jayawijaya Livestock Office, have been trained in parasite detection in pigs produced for human consumption, in pig feeding, and in modified husbandry systems based on traditional practices. The modified husbandry system also helps prevent the spread of parasites among pigs, and from pigs to humans.

An important concern, Cargill says, is that the process of improving feeding efficiency does not threaten the survival of indigenous pig breeds or encourage people to move away from locally grown crops. The objective, he says, is to make pig production more efficient, a process that should also have a favorable impact on the environment.

1 Peters is currently based in Vietnam and is employed by the International Center for Tropical Agriculture (CIAT).

A WATERSHED YEAR FOR NATURAL RESOURCES MANAGEMENT

PARTNERS FROM NEARLY A DOZEN ORGANIZATIONS, WORKING AS PART OF THE CONDESAN RESEARCH AND DEVELOPMENT CONSORTIUM, SPENT MUCH OF 2003 PLANNING THE FIRST PHASE OF A NEW, COMPREHENSIVE EFFORT TO SAFEGUARD THE BIODIVERSITY OF THE UNIQUE ANDEAN ECOSYSTEM KNOWN AS THE PARAMO

The Andean Paramo Project, which is funded by the Global Environment Facility (GEF), will provide US$600,000 for what scientists say will ultimately be a US$15 million, five-year initiative to reverse the loss of biodiversity in one of the world's most exotic ecosystems.

The paramo is a high-altitude Andean ecosystem that stretches more than 2,000 kilometers from western Venezuela to northeastern Peru. Sometimes described as a grassland archipelago, it is home to nearly 5,000 plant species including 40 percent of the world's wild potato species. The paramo is best known, however, for its signature plant, a giant-stem rosette (*Espeletia spp.*) that can withstand the extreme cold, drought, and ultra-high levels of irradiance found at high altitudes.

The paramo is also believed to be the ideal habitat for the highest growing tree genus on the planet (*Polylepis)* and the last remaining habitat for endangered wildlife such as the Andean condor (*Vultur gryphus*) and the spectacled bear (*Tremarctus ornatus*). Both of these creatures, which are dwindling in number, are unique to the paramo, the only natural ecosystem where they roam freely.

The paramo is similar in many respects to the peatlands of northern Europe, Siberia, and North America. "Over the centuries, decomposing vegetation has created a boggy layer of soil that is often more than a meter deep. The soil acts like a sponge, soaks up heavy rainfall, and gradually releases it over time," says Hector Cisneros, Coordinator of

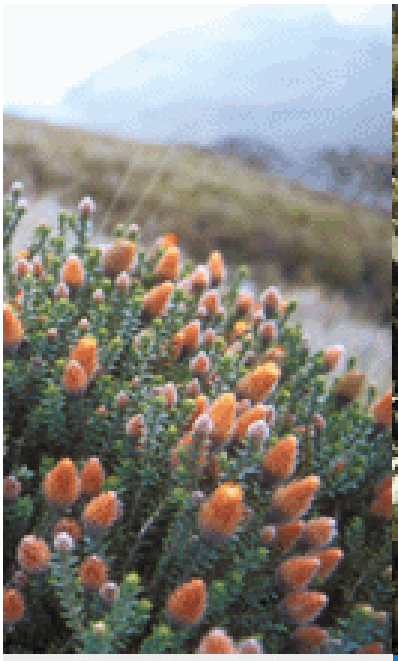
Researchers and local communities are working together through the Andean Paramo Project to ensure the conservation of this unique ecosystem and the biodiversity found there.

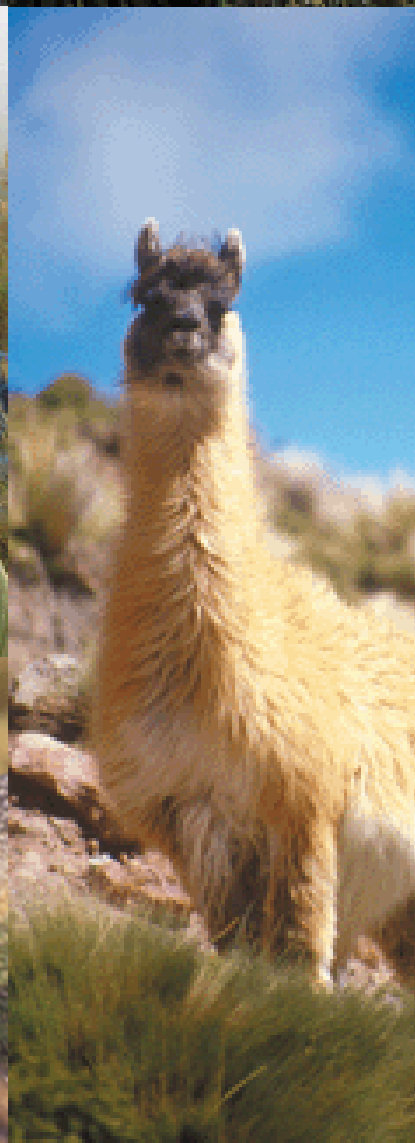
CONDESAN (Consortium for the Sustainable Development of the Andean Ecoregion).

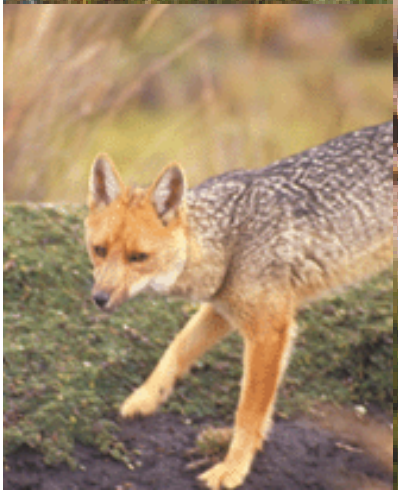
The biodiversity of the paramo is threatened, Cisneros cautions, by a variety of factors, including livestock farming and global warming, and because local institutions lack the resources and trained personnel to preserve local flora and fauna. They also face a major public awareness challenge.

"The research community needs to do a better job of quantifying and communicating to the public the environmental goods and services that the paramo provides. In addition, we need to develop policies and economic incentives that support conservation, rather than hinder it," he says.

An important step in that direction, Cisneros adds, will be to stop underestimating the value of traditional knowledge and practices of the local inhabitants, which are based on a comprehensive view of conservation. "What we need to do instead," he says, "is to start supporting them."







The Andean Paramo Project

To that end, cooperating researchers plan to launch the Andean Paramo Project early in 2004. Participating agencies will include Venezuela's

Continued on page 48

Coalition helps mountain programs regroup

Building upon momentum created by the United Nations International Year of Mountains, a new coalition of partners moved quickly in 2003 to provide the political will and financial support needed to accelerate research and development targeting sustainable mountain development.

Led by Switzerland and a variety of UN agencies, the coalition held its first meeting at the Johannesburg Summit in September 2002. "Ironically, the Summit was criticized for not producing significant breakthroughs," says Hugo Li Pun, CIP's Deputy Director General for Corporate Development, "but from the perspective of the world's mountain ecosystems, it had an important and hopefully long-lasting impact."

Li Pun notes that the CGIAR Global Mountain Program (GMP) is one of the first initiatives to receive coalition support. Established as the CGIAR's response to Chapter 13 of Agenda 21, the GMP was inaugurated in 1997 to create alliances among mountain research programs in Asia, Africa and Latin America.

"We've accomplished a lot since the late 1990s, but we should be able to do even more thanks to a US$900,000 grant from CIDA-Canada," Li Pun says. For example, working through the GMP, a variety of highland projects in East Africa will be strengthened, building on the experience of CIP and other partners in the Andes.

A new GMP steering committee was established in 2003 and includes representatives from the World Agroforestry Centre, the African Highlands Initiative, CONDESAN and CIP (representing the Andean highlands), the International Center for Integrated Mountain Development (representing the Hindu Khush-Himalayas), the International Center for Research in the Dry Areas (representing Central Asia and the Caucuses), and the Global Forum on Agricultural Research, as well as INIA-Spain and CIDA-Canada.

"We hope that this will mark a period of renewed interest and investment in mountains and mountain ecosystems," Li Pun adds. "We are at a watershed—a turning point in the evolution of this important program."

Natural resources management research readied for scaling up

CIP natural resource management work is currently being readied for major scaling up, an effort expected to benefit hundreds of mountain communities in the altiplano, or highland plains, of Bolivia and Peru.

Starting in 2004, the Canadian International Development Agency (CIDA) will begin investing CAD$19.9 million (US$15 million) in a five-year effort to build upon work conducted under the PISA farming systems project (*Proyecto de Investigacion de Sistemas Agropecuarios Andinos*). The PISA initiative, which has helped farmers avoid risks and improve their quality of life, was inaugurated in 1985 with support from CIDA and was incorporated into CIP's research portfolio in 1993.

"The problems of the altiplano are well-known," says CIP computer-modeler Roberto Quiroz. Limited market access, lack of technology, population growth, and deterioration of the region's soil and water resources are the principal culprits. Quiroz, one of nine scientists originally assigned to the PISA project, was named leader of CIP's new Natural Resources Management Division in 2003.

The altiplano region, he notes, is subject to extreme climatic conditions and drastic variability. Average rainfall ranges from 400-600 mm with drought periods that can last up to five months. In 2002—an El Niño year—thousands of local residents were affected by unusual weather, including storms that killed tens of thousands of heads of livestock. In contrast, 2003 was a drought year.

The PISA project, which concentrated on communities in the area surrounding Lake Titicaca, started as a typical farming systems project and gradually evolved to include community systems and watersheds.

"When we began our work in the mid-80s," Quiroz says, "there was little data available about mountain watersheds, forcing us to develop remote

sensing techniques and computer models to generate climate data, and understand the dynamics of local cropping patterns and soils."

From there, crop, livestock and erosion models were adapted to diverse agro-ecological zones to screen for "best-bet" options. The result was the development of a series of geo-spatial tools that produce easy-to-understand watershed and community maps. The maps take data from the different models and highlight it so that communities can understand tradeoffs between productivity increases and environmental health.

"Farmers tested all of the technological options to come out of the process and selected the ones they wanted to use," Quiroz adds. "For example, by using the models we predicted accurately that farmers who irrigated their potatoes could plant early and escape drought." Similar strategies were developed for alpaca and dairy farmers using improved fallows and legumes that nourish the soil and cut hillside erosion.

"The scaling up process, which will begin this year, validates the work started by the PISA project," says Hugo Li Pun, CIP's Deputy Director General for Corporate Development. Li Pun, a former official with Canada's International Development Research Centre, had early ties to the project. The research was continued by CIP and CIRNMA, a nongovernmental organization that provides technical assistance and credit to farmers in the Lake Titicaca area. The expansion of the work was made possible by support from the Swiss Agency for Development and Cooperation (SDC), the European Commission, the United States Agency for International Development (USAID), the Netherlands Directorate-General for International Cooperation (DGIS), and Spain's *Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria* (INIA), among others.

For more information about CIRNMA read *CIP Collaborator Wins Development Award*, page 49.

User-friendly models are helping communities in the altiplano to make better-informed decisions about the use of their natural resources.

Instituto de Ciencias Ambientales y Ecológicas (ICAE) of the *Universidad de los Andes,* the Alexander von Humboldt Biological Resources Research Institute of Colombia, *EcoCiencia* of Ecuador, the Mountain Institute (TMI) of Peru, the University of Amsterdam in the Netherlands, and the University of Wisconsin in the United States. Coordinating services will be provided by CONDESAN, operating from CIP headquarters in Lima and the Center's liaison office in Quito.

During the design phase, project scientists—in an effort to identify alternatives that might promote biodiversity conservation—will analyze the economic, social, and environmental policies that have an impact on the paramo ecosystem.

"One of our key goals is to develop a vision for the future, starting by characterizing the situation on the ground," says CIP biologist Robert Hofstede. "To that end, we will be selecting pilot sites to analyze the effects of land use change on biodiversity conservation and the maintenance of environmental services. The goal is to develop integrated land management plans," he says.

Project scientists will also seek the participation of local people, many of whom are already motivated to take part. Hofstede notes that in northern Ecuador, where farmers have worked with CONDESAN for over a decade, local communities have taken it upon themselves to act as indigenous park guards for the Paramo El Angel Ecological Reserve. Likewise, in northern Peru, local people are working with CONDESAN to preserve biodiversity threatened by mining operations.

"Ultimately what we hope to have in place are the indicators and protocols needed to establish an international monitoring network that will provide accurate assessments of the health of the paramo," says Hofstede.

He notes that the project will involve a broad range of actors at national and international levels, including advanced research institutions, nongovernmental organizations, and many community-based organizations.

"Our aim is to help implement the vision of the delegates to the Paramo World Congress held in Paipa, Colombia in 2002. The vision calls for a paramo without borders and sharing of responsibility for its well-being," Hofstede adds.

Challenges ahead

Officials associated with the project are optimistic that it has a good chance of meeting those goals.

"It's likely that we'll look back at 2003 as the year when researchers began to get a handle on the problems of mountain people and the highland environments in which they live," says CIP Director General Hubert Zandstra.

CIP COLLABORATOR WINS DEVELOPMENT AWARD

The *Centro de Investigación de Recursos Naturales y Medio Ambiente* (CIRNMA), an important CIP partner, was recently named one of the World Bank's 2003 Development Marketplace winners. CIRNMA was selected from 2,700 applicants for its innovative work with oca, a little-known Andean tuber crop.

"The oca project is helping to raise the income of rural families in and around the city of Puno, near Lake Titicaca," says CIRNMA Executive Director Roberto E. Valdivia. "Our goal is to target Puno's indigenous Aymara-speaking people and train them to produce a variety of oca jams and preserves that will meet today's exacting market standards." This will not only promote rural micro-enterprise; it will also encourage local households to conserve biodiversity as a source of extra income.

"Traditionally, wealth and biodiversity went hand-in-hand in the high Andes," says Carlos Leon-Velarde of CIP's Natural Resources Management Division, "but these days, the picture is quite different." Loss of biodiversity is particularly acute in the Lake Titicaca region, where it is coupled with one of Peru's highest poverty rates and infant mortality 30 percent above the national average.

"Population growth, food demand, increasing use of pesticides, inadequate use of fertilizers, soil erosion, and improper disposal of garbage all contribute to the problem," adds Leon-Velarde. "Recycling of organic waste for food production, another traditional strategy, recently has fallen out of favor. It needs to be reintroduced to new generations of farmers, both male and female," he says. CIRNMA's oca project will help reduce environmental pollution by producing at least 40 metric tons of organic fertilizer from recycled manure and crop residues.

The 2003 Development Marketplace identified 183 finalists and 47 winners from 27 developing countries. The award to CIRNMA, which carries with it a cash prize of nearly US$115,000, was one of just four presented to an agriculture-related project.

Even with international support and sufficient financing, however, the challenge of reversing years of neglect and mismanagement is considerable. The paramo ecoregion is a magnet for farming because of its fertile soils and the absence of pests and diseases. Large numbers of farmers, Cisneros says, are plowing up virgin areas to grow potatoes and horticultural crops for the urban market.

There is also considerable pressure on the region's last remaining native forests, as people use the land for livestock and timber production. By some estimates only 2 percent of the original high-altitude Polylepis spp. forests of the Andes remain, and even those are endangered. Efforts have been made in the past to reforest degraded areas with non-native species such as pine, affecting the paramo*'s* biodiversity, as well as its hydrologic cycles. This has placed large areas at risk.

Ironically, one of the greatest threats to the region's well-being originates in urban areas. For the people who live in many of the region's growing urban centers, the paramo is the sole source of drinking water and hydroelectric power.

"It's in everyone's interest that the paramo be protected," Zandstra says. Thanks to the support we've receiving from the GEF, the process of reversing years of neglect can now begin.

Partners move to bring urban agriculture above ground in Sub-Saharan Africa

After nearly two years of debate and consultation—aided by the Urban Harvest program—the Kampala City Council recently passed a new set of ordinances that update the rules governing urban agriculture, many of which dated back to colonial times

Kampala, one of the few African capitals established prior to the colonial era, derives its name from *kasozi k'empala*, which in the Baganda language means "hill of the antelopes." Located on the shores of Lake Victoria at 1,300 meters above sea level, Kampala thrived through the first half of the 20th century as a commercial hub for cash crop agriculture.

Today, about 60 percent of the city's land area is used for agriculture, with about 40 percent of the food eaten in the Ugandan capital being produced within the city limits. Urban Harvest, the Consultative Group for International Agricultural Research (CGIAR) system-wide initiative on urban and peri-urban agriculture, estimates that about a third of the city's households derive some income from urban or peri-urban agriculture. New regulations were sorely needed to bring this important activity into synchronization with 21st century challenges and opportunities.

"The old rules governing agriculture were focused on protecting public health and limiting access to food production for ordinary people living in the cities," says Diana Lee-Smith, Urban Harvest's Regional Coordinator for Sub-Saharan Africa. "Many of the old regulations were restrictive and even illogical in a contemporary context. They were developed under very different circumstances, and emphasized such things as

Growing crops in contaminated city land poses health risks to African farmers and consumers. Committed Kampala city officials Winnie Makumbi and Margaret Azuba (center left) played a key role in countering this threat by helping to bring about reforms in laws on city farming.

the height of crops—a theft-prevention measure—and even barking dogs. Most of the regulations were not even understood by the people charged with enforcing them," Lee-Smith adds.

21st century problems

The outdated rules also did little to tackle 21st century problems. In Kampala today, as in many African cities, food crops are often grown on abandoned industrial sites and in garages, many of which are contaminated by heavy metals.

"The old regulations, moreover, didn't emphasize what is right about urban agriculture," Lee-Smith says. "Urban agriculture is a major income generator for the poor and provides affordable vegetables, meat, and dairy products for millions of people in Africa's cities."

Lee-Smith notes that while Africa is still predominantly rural, with only a third of its people living in cities, the continent has the world's highest annual rate of urbanization: 3.5 percent.

In 2003, the United Nations estimated that roughly 300 million Africans lived in urban areas, a figure that is projected to grow five-fold over the next 25 years. They also found that 40 African cities had populations of a million or more. By 2015, 70 African cities are expected to reach that threshold.

"It's obvious that a large percentage of those African city dwellers are going to be involved in some form of agriculture," comments Gordon Prain, the CIP anthropologist who coordinates

Urban Harvest. "If we are to face this situation realistically, urban agriculture needs to be brought above ground," he adds.

Right now, because of antiquated regulations such as those that were in place in Kampala, farming is technically illegal in many African cities. This means that its practitioners work in conditions of vulnerability, uncertainty, and without the benefits of new technologies. Urban Harvest is well placed to help resolve this dilemma. Established in 2000, it brings together a cross-cutting group of partners who work to improve food security for the urban poor, increase the value of agricultural production in urban and peri-urban areas, and promote agriculture as part of the sustainable management of urban environments. Financing is provided by the Governments of Canada (CIDA), Spain, the United Kingdom (DFID), Canada's International Development Research Centre (IDRC), and the World Bank.

The Kampala model

"Kampala is an ideal place to institute reforms," says Lee-Smith. "It has a rich history in urban agriculture, serious and committed researchers, a responsive city government, and committed officials. Winnie Makumbi and Margaret Azuba are prime examples. These two women were responsible for many of the reforms recently passed by the City Council. Makumbi, a member of the Council, is the City Minister for Social Improvement, Community Development and Antiquities. Azuba is the Council's Chief Agriculture Officer and one of Kampala's leading experts on agricultural systems.

"Winnie represented the city at the Urban Harvest research and planning meetings, while Margaret was deputy leader of the research team. Both were instrumental in educating the Council about the need for reform. Together they organized the participatory review of existing legislation in accordance with Council procedures," Lee-Smith says. "From the beginning, they worked hard to include council members and the local citizenry so that all views would be brought to the table."

"The municipality and the business community," Lee-Smith notes, "were worried about health and nuisance issues, while nongovernmental organizations and community-based organizations were concerned about food security and livelihoods."

"The process that Urban Harvest established," continues Lee-Smith, "and which we hope to replicate elsewhere in Africa, helped us to find ways around the impasses that arose among the stakeholders." The partners started with

neighborhood consultations. Five formal Divisional Workshops allowed local people to provide their input by commenting on existing rules and making suggestions for reform.

"Gradually," says Lee-Smith, "we worked up from the grassroots to the district level and eventually went city-wide." The result is a new set of regulations that passed the City Council in January 2004. They are expected to be made into law following a review by national authorities.

"The new regulations, which will be translated into local languages, will simplify or nullify dozens of superfluous laws, set the stage for real reforms that will reduce health risks to farmers and consumers, and improve the quality of life in the city," Lee-Smith adds.

As a first step, the government is issuing temporary permits to farmers working within the city limits. The permits will legitimize their activities, helping to prevent harassment by unethical officials and land developers. They also will allow for a period of public education whereby farmers, as well as milk, fish, and meat traders and handlers, can upgrade their operations to meet better health standards. The city will also develop a database of farmers and traders, which to date is lacking.

"Basically the permits place urban agriculture in an arena where the city can begin to make better decisions that will benefit the population as a whole," concludes Lee-Smith.

Nairobi takes note

The Urban Harvest activities in Uganda and the reforms passed by the Kampala City Council are part of a much broader plan that includes diverse related initiatives in neighboring countries. For example, Nairobi's Deputy Mayor Lawrence G. Ngacha recently reported that the Nairobi City Council is working with the Kenyan Government to strengthen urban food security in Nairobi through improved food supply and distribution systems. He notes that the City Council is also developing projects to address urban waste management and its links to urban agriculture.

The problem of waste management in Nairobi is a significant issue. Since the 1970s, the city has tripled in size and has seen major increases in the illegal use of human waste for agriculture. Nowhere is the issue more evident that in Kibera, Nairobi's notorious slum that is home to more than three-quarters of a million people. The residents of Kibera, like many other urban poor, grow a variety of crops and vegetables using wastewater tapped from the sewage pipes.

Scientists fear that the fields, and potentially the crops themselves, are contaminated with pathogens, such as *Escherichia coli* bacteria, and

Kampala wetland agriculture is contaminated with wastes flowing in from nearby human settlements and factories.

Agriculture and heavy metals

The Nation, one of Kenya's leading newspapers, reported on December 12, 2003 that crops grown along the Nairobi River may contain high levels of lead, posing a threat to the health of local consumers. According to *The Nation*, kale, a green leafy vegetable eaten by rich and poor alike, may contain more than 15 times World Health Organization's standard of 300 micrograms of lead per kilogram.

Urban Harvest Coordinator Gordon Prain feels that the situation may be even more serious than reported. According to Prain, agriculture in African cities is often located on abandoned industrial sites that may be contaminated by a variety of heavy metals. "This poses a threat not only to consumers, but also to farmers and their families," he says.

"People understand that they are at risk, but have little choice but to continue," Prain notes. He cites the case of a Kampala woman growing coco yams in contaminated wetlands. When interviewed by Urban Harvest researchers, she told them that for her it is a question of dying 15 years from now of cancer, or perishing today of hunger.

intestinal parasites. Even so, no one really knows with any certainty the extent of the actual health risks associated with so-called sewage farming, and this creates a vicious circle of indecision: on the one hand, public health concerns would dictate that the practice be stopped; on the other, there is little scientific data available to support decision-making on instituting reforms.

In an Urban Harvest study carried out in Cameroon's capital city, Yaounde, researchers from two local universities and three international centers came up with evidence that may help Nairobi officials to move forward. They measured contamination in inland farming valleys, and although the results show that water contamination levels at different points in the local drainage system are high, they also indicate that these may pose little risk to consumers who cook their food. Little, if any, food is eaten raw in traditional African cooking.

Recommendations to ban sewage farming in inland valley areas, the researchers contend, may therefore be premature. The health risks to farmers themselves, nonetheless, and the risks of eating uncooked foods require awareness-raising programs. Continued research is also needed to understand the complexity of disease pathways as well as other health risks associated with urban agriculture.

The study was carried out by the University of Yaounde, the Ecole Nationale Polytechnique Supérieure (ENPS), the International Institute of Tropical Agriculture, the World Fish Center, and the World Agroforestry Centre, in cooperation with the City of Yaounde and Cameroon's *Institut de Recherche Agricole pour le Développement*, *Centre de Coopération Internationale en Recherche Agronomique pour le Développement*, *Institut Supérieur des Sciences Economiques Appliques*, and *Institut National de Cartographie*.

HARNESSING THE TREND: A MILLENNIUM STRATEGY FOR AFRICA

CIP'S SUB-SAHARAN AFRICA RESEARCH PROGRAM MOVED QUICKLY IN 2003 TO RESPOND TO NEW INVESTMENTS BY PUBLIC SECTOR DONORS AND PRIVATE PHILANTHROPIES THAT TARGET FARMING COMMUNITIES IN BOTH RURAL AND URBAN AREAS

CIP scientists will use the new resources—totaling more than US$3 million over a three-year period (2004-2006)—to bring improved technologies to bear on the problem of food security, and on growing concerns about the health of agricultural workers.

After nearly two years of consolidation, the Center is rapidly rebuilding its research teams in Kenya and Uganda, and strengthening ties to national programs through the PRAPACE and ASARECA networks. According to Charles Crissman, CIP's Regional Leader for Sub-Saharan Africa, CIP now has the staff needed to meet local seed requirements and to integrate important breeding and crop management projects with new initiatives in health and urban agriculture (see *Partners Move to Bring Urban Agriculture Above Ground in Sub-Saharan Africa,* page 50).

"We're a small team with a big job," he says. "With the resources we're now receiving—and with proper targeting—CIP technology can harness many of the trends that are moving in our direction." Among those, Crissman contends, are high growth rates for Africa's potato and sweetpotato crops (13 and 6 percent respectively according to FAO), numbers that far exceed population growth.

Support for CIP's Africa projects is provided through unrestricted contributions made by CGIAR donor agencies (see page 89 for a list of CIP's core donors), along with restricted funding from the Canadian International Development Agency (CIDA), the German Ministry on Economic Cooperation and Development (BMZ), the United

Kingdom's Department for International Development (DFID), and the United States Agency for International Development (USAID).

Targeting opportunity

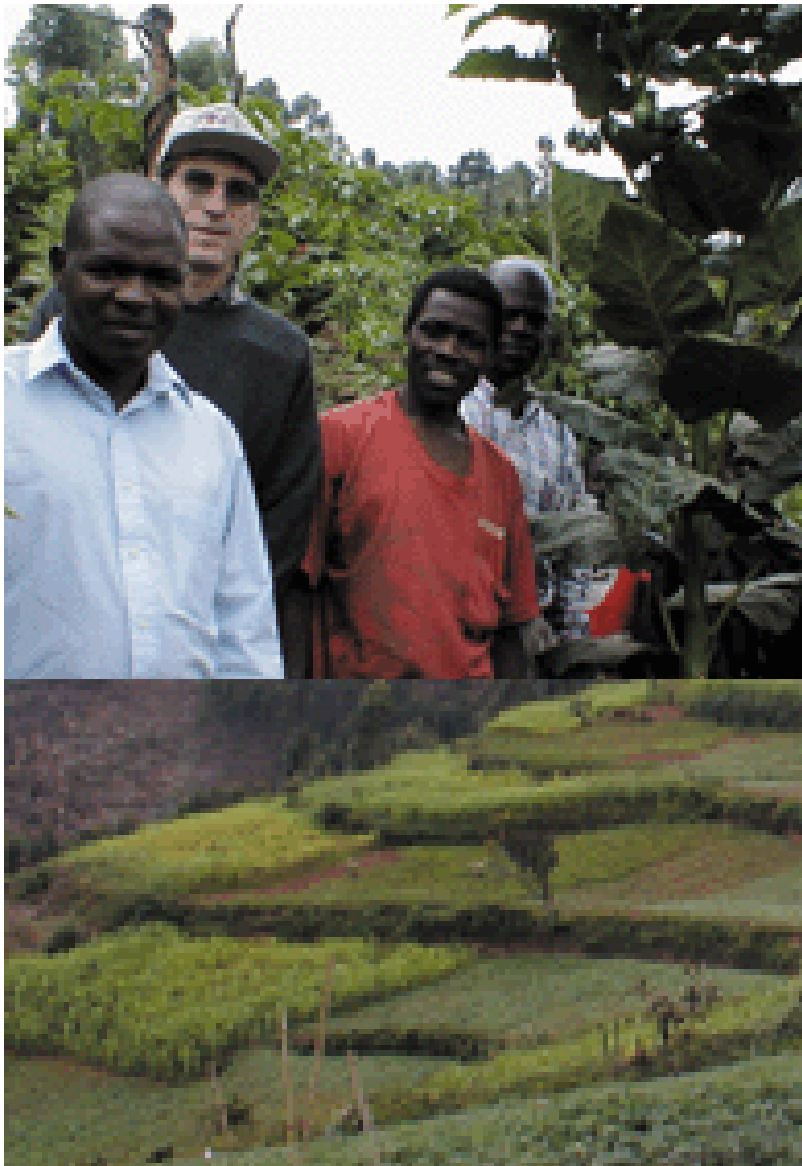
CIP's recent visioning exercise helped to pinpoint Africa's US$50 billion domestic food market as a priority for on-going research and development, Crissman notes. Although Africa exports about US$7 billion dollars annually of commodities like cocoa and coffee, this export market is unlikely to offer significant opportunities for smallholder potato or sweetpotato farmers over the next five or ten years.

"Africa's potato and sweetpotato producers can gain from exports," Crissman says, "but should focus on regional trade, and then only after serving the domestic market. Supplying local consumers will be a big enough challenge as population grows and as Africa urbanizes. Producers should focus on adding value in their home markets first and think about exports later."

Traditionally, most of Africa's potatoes and sweetpotatoes are eaten close to the locations where they are produced. The dynamics of the market, however, are creating a shift in the trend. As more and more people move to cities, potatoes and sweetpotatoes are being transported to urban areas, where they fetch higher prices. Moreover, as urban dwellers become more familiar with the crops thanks to street vendors, people are gradually modifying their diets.

"The African urban market for starchy staples is expanding and is potentially huge," Crissman says. "African farmers should go for the logical market, and researchers need to help them get there."

To that end, CIP plans to apply strategies developed through its experience in Latin America, in particular, a model provided by the



Papa Andina project to help national partners create linkages between farmers, markets, and local manufacturers. *Papa Andina* works in the Andes to shift research and development efforts away from a strict production orientation, helping farmers to express their needs, access information, and develop business opportunities.

Breaking out of subsistence

"We're not trying to push something new," Crissman says. "Smallholder potato and sweetpotato farmers are already marketing their crops to urban consumers. The question that researchers need to answer is: How can we simultaneously help farmers increase their profits, avoid oversupplying the market, and prevent environmental degradation?"

Crissman believes that the answer lies in giving farmers greater control over their crops. "Right now, farmers have little shock absorption capacity. When something goes wrong, it does so in a big way." CIP's primary task, Crissman adds, is to deliver technology that will help African farmers manage risk and improve their return on investment.

Sweetpotato provides an excellent starting point. Although the crop's biological yield potential exceeds 100 tons per hectare, African farmers usually produce just a fraction of that amount, and much of what that they do harvest is lost to weevils.

"We haven't found a single source of genetic resistance to weevils and we've tried almost every imaginable management technique to control them," Crissman says. "Nothing seems to work."

Accordingly, CIP—as part of its visioning exercise—has assigned a high priority to the production of a genetically engineered sweetpotato that can resist infestation

CIP scientists are making strides to green African fields and provide farmers with urgently needed solutions to their food and income problems.

(see *Advanced Technologies Readied for Potato and Sweetpotato Producers,* page 21*)*. Center scientists are convinced that the technology is safe and effective. "Transformation, in this case, is a last resort, but one that will save lives," Crissman contends.

The project will be conducted under the auspices of the BioScience Facility, a US$21 million initiative financed by the Canadian International Development Agency. The new facility, Crissman notes, will be the first to specifically support the *New Partnership for Africa's Development* (NEPAD).

Focus on late blight

"We'll also be giving a higher priority to potato late blight disease, but in this case we won't have to wait three or four years, or resort to hi-tech genetics to move ahead," Crissman says.

According to CIP plant breeder Juan Landeo, national programs have already released some 60 potato varieties derived from CIP's late blight resistant breeding lines, and more releases are expected. CIP materials now cover about 10 percent of the potato acreage in countries such as Ethiopia, Kenya, and Uganda. Landeo, who produced some of Latin America's most popular potato varieties, anticipates that coverage will increase considerably following the introduction of a new series of breeding lines derived from traditional Andean varieties.

The new lines, which are scheduled to reach Africa some time in 2004, were bred from the species *Solanum andigena*, a traditional type of potato that is widely grown in the high Andes, but is largely unknown outside the region.

CIP pathologist Greg Forbes, who heads up the Center's late blight program, notes that the *andigena* potatoes, which are excellent for processing and carry superior disease resistance, are being introduced at a time of growing concern about late blight.

"In recent years, the spread of more aggressive strains of the fungus-like organism that causes late blight has led to dramatic crop losses and sparked a rise in the use of toxic chemicals," he says.

Sub-Saharan Africa, Forbes believes, is the only region where older forms of the pathogen still predominate. "It's almost inevitable that new disease strains will migrate to Africa's potato fields, and, when they do, the new *andigena* lines should be ready to help farmers to cope."

The new *andigena* potatoes will undergo extensive testing before reaching farmers, probably sometime in 2006.

African farming systems stand to benefit from the application of tradeoff models, which have already proven their usefulness in Ecuador.

Tradeoff Analysis research moves to Kenya and Peru

Following the successful use of Tradeoff Analysis modeling in Ecuador's pesticide-intensive potato cropping systems (see CIP annual reports 2001 and 2002), CIP plans to intensify this work under the umbrella of its new Agriculture and Health Division. To heighten their contribution to the UN Millennium Goals in health and sustainable development, Center scientists will apply the Tradeoff model to diverse research topics, beginning with studies of soil fertility and carbon sequestration in central and western Kenya, respectively.

The project will help researchers to appraise the vulnerability of local production systems and to assess alternatives. Economist Charles Crissman, who headed up the Center's Tradeoff work in Ecuador and now serves as CIP's Regional Representative for Sub-Saharan Africa, describes the technique as "a modeling exercise wrapped up in a participatory research process."

The project—which is financed by the United States Agency for International Development (USAID) and the Netherlands Directorate-General for International Cooperation (DGIS)—will be conducted in cooperation with researchers from the International Livestock Research Institute, the Kenya Agricultural Research Institute (KARI), Montana State University, Wageningen University, and the World Agroforestry Center. A similar Tradeoff Analysis study designed to examine the relationship between nutrition, infectious diseases, and land degradation will begin in Peru in 2004.

VITAA wins CGIAR Partnership Award

Researchers and farmers from seven countries representing the Vitamin A for Africa (VITAA) partnership were awarded the Consultative Group on International Agricultural Research's (CGIAR) Partnership Award. The award, which carries a US$10,000 stipend, was presented by Ian Johnson, Vice President of the World Bank and Chairman of the CGIAR at the Group's annual general meeting in Nairobi. It recognizes the VITAA partners' efforts to combat vitamin A deficiency, one of Africa's most serious public health problems.

Vitamin A deficiency—a leading cause of early childhood death and a major risk factor for pregnant and lactating women—does not kill directly, but rather weakens the immune system, leaving its victims susceptible to deadly diseases such as measles, malaria, and diarrhea.

"VITAA offers a common-sense solution to this major public health problem," says Project Coordinator Regina Kapinga, "by providing community groups with new orange-fleshed sweetpotatoes that have high levels of pro-vitamin A." Kapinga, a Tanzanian agronomist, is based at CIP's field office in Kampala, Uganda.

"Sweetpotato is a women's crop," Kapinga goes on to explain, "and women farmers have been fast to take up the new sweetpotatoes because they recognize the benefits for themselves and their children."

VITAA is supported by the German Ministry on Economic Cooperation and Development (BMZ), the United Kingdom's Department for International Development (DFID), the OPEC Fund for International Development, the Micronutrient Initiative, the United States Agency for International Development (USAID), the Senior Family Fund (USA), and important CGIAR donors who generously provide unrestricted funding for CIP research.

Northeast Indian farmers and consumers benefit from novel seed technology

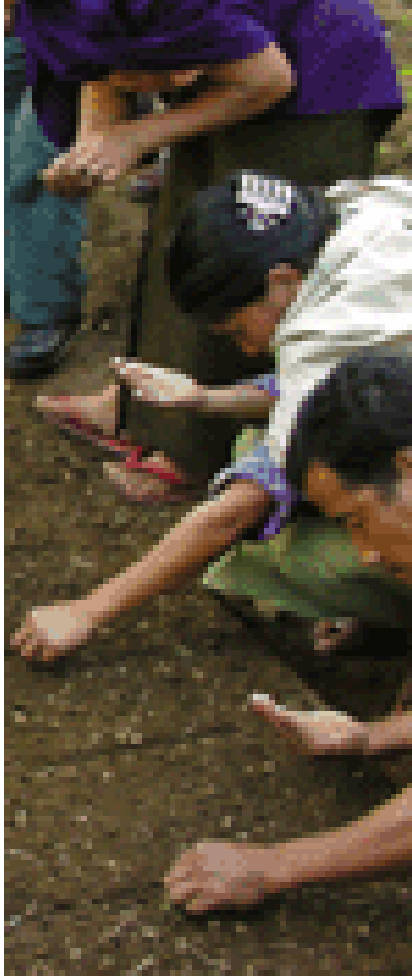
Potato farmers located in India's poverty-stricken northeast are beginning to reap important benefits from a seed production practice that dramatically increases yield and eliminates the need to transport tons of conventional tuber seed across rugged mountain terrain

True potato seed technology, which some observers believe was once used by the ancient Incas, is helping to resolve a series of longstanding problems and is providing significant cash income to the rural poor in northeast India, an area sometimes referred to as the Seven Sister region.

In Tripura, one of the Seven Sister states, women entrepreneurs working through self-help groups are opening bank accounts with the income earned from the sale of high-quality potato seed. Using TPS, or true potato seed (see *True Pototo Seed*, page 65), Tripura's women are generating thousands of tons of potato seed each year and selling it to farmers eager to profit from yield increases that easily approach 35 tons per hectare, twice the national average. The quality of the women's product is said to rival the best seed available on national and international markets.

In the past, Tripura's state government purchased about 1,000 tons of certified seed tubers each year from sources outside the state and sold them to farmers at subsidized prices. The imports cost about 2 million rupees (US$44,000) per year—a considerable sum in northeast India—but met only about 25 percent of the state's potato seed requirements.

The TPS hybrids used by the women of Tripura were developed in the 1990s by CIP scientists working in collaboration with researchers from India's Central Potato



FARMERS IN NAGALAND HAVE BEEN QUICK TO ADOPT TRUE POTATO SEED AS A VIABLE ALTERNATIVE TO COSTLY, DIFFICULT TO TRANSPORT TUBER SEED.

Research Institute (CPRI), a longtime CIP collaborator. Approximately 30 percent of the 90,000 tons of potatoes grown each year in Tripura are said to be produced using TPS.

"Tripura's success with TPS," says researcher Sarath Ilangantileke, "is largely due to the savings and profits it provides to farmers. At the same time, local production of TPS solves a longstanding dependency on expensive and difficult to transport tuber seed."

Ilangantileke, CIP's Regional Representative for South, West and Central Asia, notes that TPS cuts production costs in half and is quickly finding a niche as a low-cost, high-quality alternative in places that lack the roads and the infrastructure needed to produce or distribute bulky tuber seed.

THE SEVEN SISTERS

Ilangantileke's description is true not only of Tripura, but portrays much of the area covered by the Seven Sister states. A classic example is Nagaland, a remote tribal region of 20 million people, many of whom depend on slash-and-burn agriculture for subsistence.

Among the 16 ethnic groups that reside in Nagaland's rugged mountain terrain, potato is a major part of the diet. In recent years, however, potato production has declined steadily because of the scarcity of quality seed tubers.

"Nagaland does not produce potato seed," says Ilangantileke. "The farmers depend on outside sources for their planting materials." In the past, this has meant relying on tuber seed transported across 1,700 kilometers of mountain roads, from places as far away as Shimla in the north-central part of India.

According to Supong Kietzar, Nagaland's Director of Agriculture, the two tons of tuber seed needed to plant a hectare of potatoes costs about US$450, well beyond the means of most local farmers. Although the state government subsidized seed costs until 1999, those subsidies have since been withdrawn.

To compensate, in 2001 the State Agricultural Research Station (SARS) began experimenting with TPS produced in neighboring Tripura. Kietzar reports that in on-farm trials, SARS researchers recorded yields of more than 20 tons per hectare, nearly three times the amount produced by farmers who planted their crop with tuber seed.

"TPS is well suited to conditions in Nagaland," comments Ilangantileke. "It's easy to handle and

True potato seed, or TPS, is produced in berries that grow among the plant's foliage.

True potato seed

TPS—true potato seed—is harvested from the berries that grow among the foliage of potato plants. An average plant produces dozens of berries, each of which contains hundreds of tiny seeds.

Similar in appearance to tomato seed, TPS is usually sown in seedbeds three or four weeks prior to the potato planting season. The plants in the beds produce small tubers, sometimes called tuberlets, which farmers plant in the field much as they would conventional seed tubers.

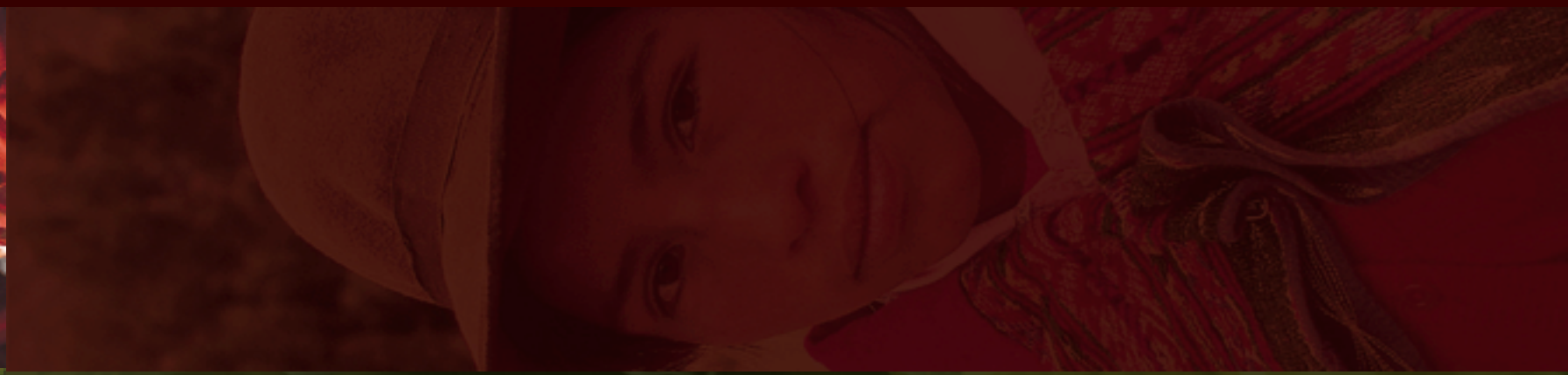
This practice sidesteps much of the drudgery involved in handling heavy seed tubes, provides farmers with vigorous disease-free seed, and eliminates the need to store part of the previous year's crop for following year's planting. (Many of the production problems that potato farmers experience result from the deterioration of the seed tubers they save for planting, storing them for eight to nine months in inadequate storage facilities.)

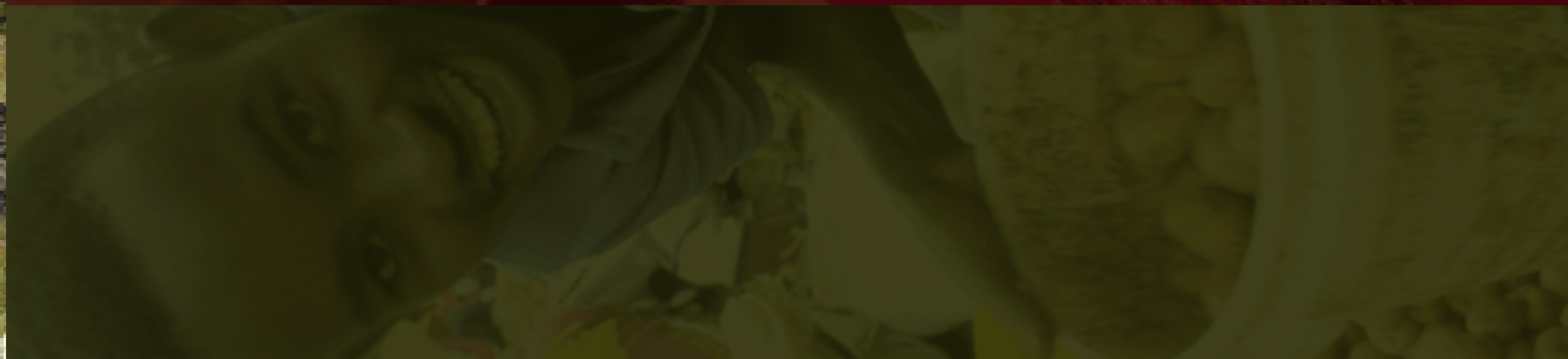
TPS tuberlets, which are normally no larger than 2.5 centimeters in diameter, rival the best tuber seed produced by commercial seed companies. CIP-derived TPS hybrids are now widely used in Egypt, India, Indonesia, Nicaragua, and Vietnam.

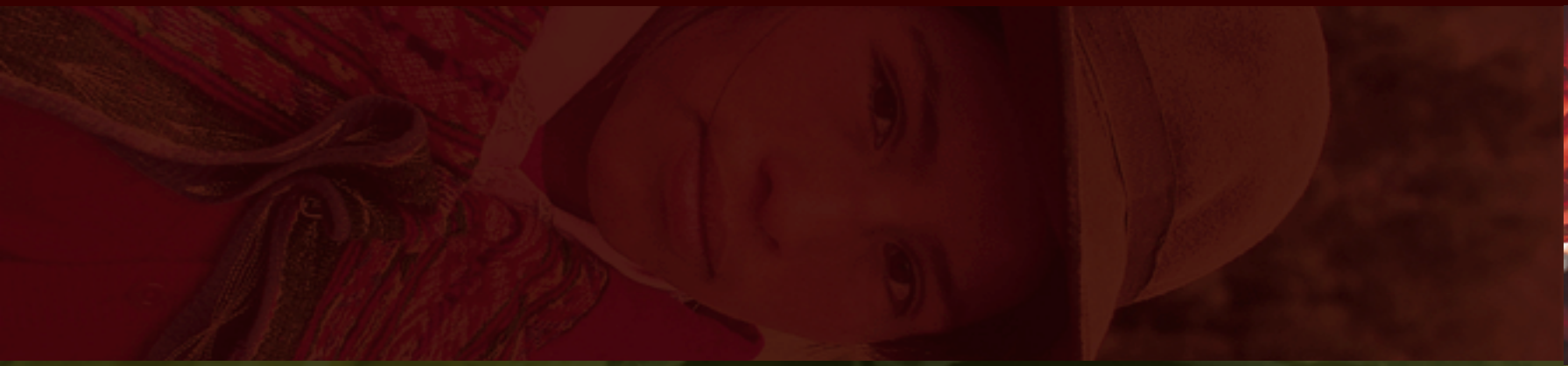
move around, and it's virtually free of diseases and pests. Fifty grams of TPS contains about 80,000 seeds, an amount sufficient to produce enough tuberlets (see *True Potato Seed*, page 65) to plant a hectare." Farmers who use conventional tuber seed, Ilangantileke points out, have to plant approximately 2 tons of tubers to cover the same area.

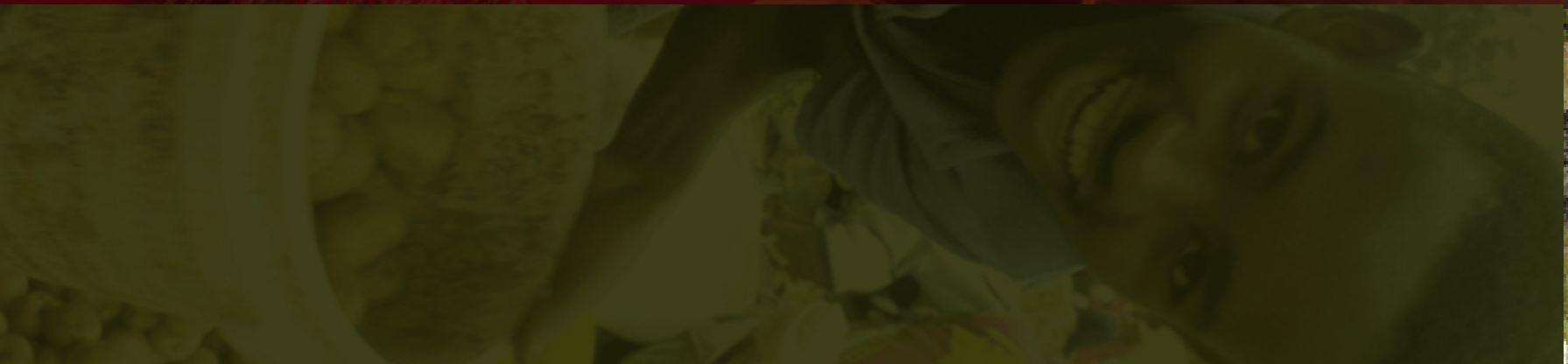
According to Kietzar, the results obtained to date in Nagaland are so encouraging that the state government has begun sending SARS staff to Tripura for training in TPS production. The courses are conducted with assistance from the CIP Regional Headquarters in New Delhi.

In addition, the University of Nagaland recently announced plans to partner with CIP in an effort that will focus on TPS, as well as conventional seed development and varietal trials. According to Dr. G. B. Sharma, the University's Vice-Chancellor, a CIP liaison office will be established on the University campus sometime before the middle of 2004. The partnership is expected to accelerate technology development relevant to the needs of local farmers and promote better linkages with nongovernmental organizations and community-based organizations.









In brief

Making the case for Andean roots and tubers

As part of an ongoing effort to spread reliable and synthesized information on lesser-known Andean root tuber crops (ARTC), CIP in 2003 published "*El Yacon: Fundamentos para el aprovechamiento de un recurso promisorio*." The product of extensive collaboration, the volume provides a comprehensive review of the health benefits attributed to this crop.

Over the past few years, yacon—a member of the sunflower family grown for its sweet, low-calorie, edible roots—has made a remarkable transition from neglect to significant market presence in Peru, primarily thanks to efforts to make known the health benefits associated with it.

Yacon contains sweet-tasting oligo-fructans, a carbohydrate the human body has no enzyme to digest. These substances thus pass through the digestive tract unmetabolized, making the consumption of yacon as a sugar substitute increasingly popular among dieters and diabetics. The publication—produced by CIP and Peru's University of Cajamarca—provides the first comprehensive review of the health benefits attributed to yacon.

"I believe this is an important step towards substantiating health claims made for yacon, which will help to gain regulatory acceptance in target markets," says Andean crop specialist Michael Hermann, head of CIP's ARTC Collaborative Biodiversity Program.

In addition to being used by diabetics as a natural sweetener, research has shown that yacon can potentially help increment the assimilation of calcium in the bones, reduce

the risk of developing colon cancer, and strengthen the immune system, among other benefits.

Obtaining regulatory approval from the major health boards of target markets such as the US Food and Drug Administration (FDA) is key, according to CIP biologist Ivan Manrique, as it would contribute to the controlled sale and promotion of yacon and yacon-related products.

"The reckless dissemination of inaccurate information—namely exaggerated health claims—can ruin a crop's image and credibility," Manrique explains. Maca is a case in point. Although its qualities as an energy booster have been proven, some distributors have wrongfully marketed maca as the "Andean Viagra."

"*El Yacon: Fundamentos para el aprovechamiento de un recurso promisorio*" is one of the outputs of the ARTC Collaborative Biodiversity Program, financed by the Swiss Agency for Development and Cooperation (SDC). In addition to promoting and supporting new research activities, the program—carried out by CIP and a handful of institutions from Bolivia, Ecuador, and Peru—encourages improved use and marketing of these crops.

In addition, CIP is in the process of putting together a series of nine Spanish-language publications on Andean root and tuber crops. The topics range from the *in situ* conservation of oca in Peru, to the sustainable development and conservation of these crops in Bolivia and Ecuador.

Moreover, CIP and the International Plant Genetic Resources Institute (IPGRI) are jointly publishing a sequence of publications on under-utilized and neglected crops, including a mashua crop monograph, an ulluco production manual, and an impact study of ulluco post-harvest technologies. More volumes of this nature are expected to come on line this year.

Publishing reliable and accurate information, concludes Manrique, helps fill a void of dependable information on lesser known roots and tubers and also encourages the use of these crops locally and abroad. In the Peruvian provincial town of Oxapampa, for example, CIP is collaborating with an association of yacon growers and has supported a special flyer to promote their products in the local market and abroad.

The ultimate goal of these and other similar CIP-led initiatives is to boost the demand for these Andean crops and help the farmers who produce them establish commercial links with potentially lucrative markets, thus improving their incomes and livelihoods.

New snares for the Andean potato weevil

CIP and a group of partner organizations have identified innovative control measures for one of the Andean highland's most serious potato pests, the Andean potato weevil. The techniques being developed could help resource-poor potato farmers reduce severe production losses resulting from weevil attacks—crop damage of up to 50 percent—while reducing the amount of highly toxic pesticides used to control the pest.

For years, CIP scientists have been searching for biologically safe, integrated pest management methods to control and eliminate the Andean potato weevil. Food attractants and sex pheromones are successfully used to control various other pests, which are drawn to smell-exuding traps. The technical difficulty in identifying similar compounds for the Andean potato weevil, however, has resulted in a lack of available information on similar methods for this pest.

With this in mind, a group of scientists and researchers from CIP, Bolivia's PROINPA Foundation and the United Kingdom's Natural Resources Institute (NRI) joined forces last year to launch a research project aimed at identifying pheromones or volatile food plant attractant chemicals that would be effective in luring the Andean potato weevil.

"The idea is to find alternate ways of attracting the weevil that can be used to monitor its populations and to control it through trapping systems," explains Oscar Ortiz, Head of CIP's Integrated Crop Management Division.

The collaborative study, led by PROINPA and supported by the UK's Department for International Development (DFID), involved laboratory and field tests in Bolivia and Peru, where weevil infestations are extensive. The results revealed that sex pheromones were not an influential factor in trapping and controlling the weevils. On the other hand, they did show clear evidence of the attraction of adult weevils to potato leaf volatiles.

Analyses conducted by NRI indicated that two particular potato leaf compounds provoked a positive response from the weevils. These compounds were synthesized at NRI and tested as lures in pitfall traps at a PROINPA field station near Cochabamba, Bolivia. The results showed significantly higher numbers of catches in the traps baited with leaf volatiles, compared to the unbaited controls. Work to develop effective trap designs has also been carried out.

"This opens an interesting window for controlling Andean potato weevil in the near future, as scientists could produce synthetic semiochemicals that the insects would respond to," Ortiz explains. "These compounds could then be used in trapping systems to eliminate the insects directly, or as monitoring devices to enable optimal timing in applications of biological control agents or low-toxic pesticides."

Local partners become deans of farmer field schools

Potato farmer field schools (FFS), introduced in Nepal by CIP in 1999, have moved into the country's mainstream research and extension activities thanks to a groundbreaking national policy authorizing government agencies to allocate US$600 per farmer field school activity conducted.

From 1999 to 2002, the CIP-led Users' Perspectives With Agricultural Research and Development (UPWARD) network worked with various government agencies and nongovernmental organizations in Nepal to develop a field school approach for potato integrated crop management. The Nepalese Department of Agriculture and CARE Nepal were lead partners in the project, which trained over 1,300 farmers in 21 districts during the four-year period.

The partners realized, however, that disseminating the methodologies to other districts would require long-term funding. While extension workers were keen to implement farmer field school activities, they lacked funding to travel to remote potato farming communities, and to secure clean seed and training materials. His Majesty's Government of Nepal (HMG) funding could only be accessed if there was an officially approved allocation from the annual government budget for these agricultural extension activities.

Recognizing this, the project partners joined forces with the FAO Community Integrated Pest Management Program and local organizations to campaign for a national field school policy. They formed a working group, which developed a

position paper and conducted a series of dialogues with Ministry of Agriculture officials. The farmer field school promoters relied on documented experiences in rice, potato, and vegetable field schools to support the policy-making process.

In 2003, these concerted efforts led to the inclusion of a special provision supporting the implementation of FFS activities within Nepal's new five-year National Development Plan. For its part, the nongovernmental sector has extended support for training and information capacity development. Besides sponsoring training-of-trainer activities, CARE Nepal has published Nepali and English versions of manuals and technical guides. Recently, the project reached a formal agreement with CARE for three of its field offices to serve as regional learning and resource centers.

Similarly, in Indonesia, CIP's nongovernmental partners are taking on an equally important role in farmer field school promotion. Building on previous CIP research in the country, UPWARD and VECO Indonesia, with its network of over 40 local nongovernmental organizations, began scaling up efforts in 2001.

Their main project site is in the Dompu district of the drought-prone island of Sumbawa in eastern Indonesia where sweetpotato is a key survival crop for poor farming households. After the wet season, when the sole rice crop is produced, sweetpotato sustains food supplies and livelihoods throughout the eight-month dry season, when zero rainfall is normal.

By 2003, five local nongovernmental organizations had conducted 63 farmer field school activities. More importantly, farmer field school approaches initially developed for sweetpotato were adapted to other key food crops, particularly in food-deficient villages. Group learning activities have also mobilized farming communities to initiate collective action against other constraints, such as crop damage by wild pigs—a major pest—using pest control measures that conform with strict Moslem religious norms.

"These project experiences," concludes UPWARD coordinator Dindo Campilan, "demonstrate that CIP collaborative research not only offers technological solutions, but also creates effective platforms for institutionalizing and sustaining local agricultural innovations."

Better decision making reduces chemical use

In an on-going effort to combat potato late blight disease and reduce the use of fungicide among resource-poor farmers, CIP and its partner organizations are exploring the possibility of developing simple Decision Support Systems (DSS) for low-income farmers.

One of the most difficult aspects of fungicide usage in the control of late blight—the most serious potato disease worldwide—is determining the correct levels of application. In industrialized countries farmers rely on Decision Support Systems that incorporate sophisticated equipment and communications networks to help them time fungicide sprays. Systems like these, however, are not available to resource-poor farmers in the developing world.

To create an alternative for developing-country farmers, CIP—together with the national potato program in Ecuador—set out to find an easily accessible environmental parameter that could be used to control the amount and frequency of their spraying.

"The aim of our work," explains Gregory Forbes, leader of CIP's Potato Integrated Crop Management Project, "is to find an appropriate technology to help fill the technology gap."

The answer the scientists came upon was measuring accumulated rainfall.

"Wash-off of fungicides resulting from rainfall continues to be one of the principle problems associated with contact fungicides in rain-fed ecologies. These fungicides only protect the plant on its surface, but they don't penetrate into it," says Forbes. "Measuring accumulated rainfall, therefore, can give farmers an unbiased measure of whether too much fungicide has been washed off."

Based on preliminary studies and previous research done in Colombia, scientists hypothesized that using recommended doses, the wash-off from applications of common late blight fungicides (*chlorothalonil* and *mancozeb*) would result in dangerous levels after 10, 20 and 30 millimeters of accumulated rainfall for susceptible, moderately resistant and resistant crops, respectively. These thresholds were tested in 2002 and 2003 in Ecuador.

The results demonstrated the efficacy of utilizing rainfall thresholds as a decision support system for managing potato late blight at the two testing locations. Further research is needed to expand the application domain of this technology to other potato-producing developing countries.

"The most efficient treatment was the one that resulted in the lowest number of sprays," says Forbes. "In the long run, this will help farmers to better protect their crops while saving money and safeguarding their own health, and the health of their environment."

New markets for native potatoes

A surge in the use of native potatoes in dishes served at Lima's top restaurants—coupled with a boost in international media exposure of Peru's cuisine—has indeed helped put the spotlight on "native" potatoes grown by subsistence farmers in the tuber's highland home.

Representatives of CIP, local agriculture organizations, and Lima's gastronomic community are taking advantage of these trends to help Peruvian native potato producers increase their incomes. By establishing commercial and cooperative links between the farmers, and local and foreign markets eyeing this indigenous crop, they hope to help them to capitalize on their heritage, creating a path to better livelihoods.

The partners, including the Peruvian National Agricultural Research Institute and Ministry of Agriculture, joined forces in 2003 to form the market-chain association CAPAC PERU (*Cadenas Productivas Agrícolas de Calidad*).

"The overall idea," explains CIP economist Thomas Bernet, "is to create new marketing opportunities for Andean farmers and generate a favorable image for native potatoes. We have to make people understand that these potatoes are excellent food: they are natural, tasty, and healthy," he adds.

To reach their goal, CIP and partners are coordinating with local farmers to supply a portion of their ware to restaurants and cooking schools in Lima. Currently, only a few varieties of native potatoes reach Lima markets. About fifty potato farmers from the small Andean village of Huasahuasi expressed interest in getting involved during an informal meeting between project leaders and farmers late last year. Many chefs have also shown their support and are creating new native potato-based gourmet dishes.

Another effort of this collaborative project involves the development of novel processed products made from native potatoes, namely potato chips and mashed potato powder. Native potatoes are ideal for processing because of their high level of dry matter. They also have excellent frying characteristics, absorbing less oil than commercial

varieties—a fact that is much appreciated by health-oriented consumers.

Agriculture provides paths out of urban poverty

CIP and partner organizations are spearheading efforts to improve the livelihoods of farmers in Lima's shantytowns by helping them identify and seek solutions to the numerous problems they face in producing and marketing their vegetable and livestock products.

Food insecurity plagues large numbers of impoverished households in and around Lima, where agriculture continues to be an important source of food and income.

With this in mind, Urban Harvest, a CIP-coordinated program, launched a new research project in shantytowns east of Lima to evaluate and improve urban agriculture's contribution to poverty alleviation. This multi-institutional and interdisciplinary project—funded by the Government of Spain—addresses, among other things, animal and crop production issues, marketing constraints, and environmental concerns.

Some of the institutions involved in the initiative include Peru's National Agricultural Research Institute (INIA) and Institute for Research in Nutrition (INN), as well as local nongovernmental organizations such as Tecnides and IPDA (*Instituto Promoción y Desarrollo Agrario*).

Urban Harvest and small-scale farmers from the project area began by convening a workshop at CIP headquarters to identify key aspects of urban agriculture that could be improved through joint efforts. At this meeting, held in mid-2003, the participants agreed on strategies to help realize the necessary improvements, such as building better alliances and greater social capital among farmers, and improving understanding among stakeholders through roundtable dialogues.

The workshop—which also involved CIP agricultural economists, plant breeders, pathologists, agronomists, geographic information system (GIS) specialists, and social anthropologists—provided insights into the relevant crop and livestock production systems, as well as the policy issues affecting local producers. Workshop discussions demonstrated that one of the main constraints confronting urban agriculture was the absence of local policymaking and planning procedures.

"Many city planners do not recognize agriculture as being a viable urban activity. Instead, they consider it a public nuisance," explains Gordon Prain, leader of the Urban Harvest program.

An important element of the project, therefore, is providing information to local municipal agencies and planning bodies on the positive benefits that urban agriculture can generate for human health, the city environment, and recycling of urban waste products.

The project also seeks to build farmers' capacity to use and adapt improved pest management strategies and to take advantage of market opportunities. It emphasizes the use of social and discovery-based learning, including farmer field school methodologies, group learning, and hands-on activities. "In this learning-by-doing process of education," explains Prain, "researchers act as catalysts in the social learning process among farmers. Emphasis is placed on improving and enhancing farmers' already existing knowledge through practical experiments carried out in their own fields."

Additionally, research partners and local municipal authorities are using a stakeholder and policy dialogue model to directly contribute to long-term urban development. Part of the

implementation of this model involves conducting analyses that will help to better understand the local agricultural groups and associations, the municipal level departments and officials, and how these groups interrelate.

As part of the official project launch, a meeting of Lima mayors was convened in November 2003. During the meeting, senior policy makers from Havana, Cuba and Cuenca, Ecuador, described how their cities had successfully implemented integrated urban agriculture programs. Following the meeting—which was also attended by local government authorities, nongovernmental organizations and Urban Harvest staff and research associates—the local mayors signed a declaration supporting the integration of urban agriculture within their municipal development plans.

Potato DNA fingerprints go online

Scientists from CIP and the Scottish Crop Research Institute (SCRI) have worked together for nine years to develop an innovative molecular tool that allows the creation of a standardized database containing DNA fingerprints of nearly 1,000 types of cultivated potatoes.

The database complements information obtained from CIP's cultivated potato collection, which is already characterized according to morphological and molecular descriptors, taxonomy, and disease and pest resistance. The collection, held in trust by CIP, is comprised of more than 5,000 clonal and true seed accessions, and contains a diverse assortment of landrace potatoes collected from wide ranging agro-ecologies.

By adding molecular markers—highly reproducible descriptors that are neutral in terms of environmental influences—to the collection's characterization data, scientist are able to improve the precise identification of the potato accessions held in CIP's genebank.

Molecular biologist Marc Ghislain explains that the documentation of genetic identity in *ex situ* collections such as CIP's contributes to the safeguarding of original types in germplasm repositories, the identification of varietal distinctness and pedigree, and the registration of varieties.

The database works by using the high genetic variability of Simple Sequence Repeats (SSRs), which are tandem repeats of 1-5 nucleotides. The repeated numbers reveal genetic differences among individuals.

In addition to supplying key genetic information, SSR technology is also appropriate for developing-country laboratories and breeding programs with modest funding and/or expertise in molecular techniques.

Anticipating that SSR data will grow at CIP and abroad, scientists developed the SSR database to meet the following objectives: include a publicly accessible DNA fingerprint for each potato accession held in CIP's genebank; standardize formats and descriptors for new SSR markers; and store data produced through Generation, the CGIAR Challenge Program on genetic diversity (50 SSR markers on 1,000 accessions).

Researchers from CIP and SCRI—the founding group of the potato SSRs—are also spearheading efforts to develop a web-accessible SSR database. Two groups of potato geneticists, at the University of Idaho and at Argentina's *Insituto Nacional de Tecnología Agropecuaria* (INTA-Balcarce), have expressed interest in contributing to the initiative. They will begin by reviewing the prototype to improve accessibility and load data developed at their institutions.

The web-enabled version of the database includes a Search and Sort feature, as well as internal and external hyperlink access to other information sources. A local BLAST search feature on nucleic acid sequences, which are used to determine optimum primers for each SSR marker, will eventually be added.

The database's content is currently searchable by locus, PCR primer information, experiment, chromosome, allele, and genotype; in the future, access via a genome map should be possible. Each entry point leads to a table of downloadable data that displays the work of CIP and SCRI researchers, as well as a recently published report on minimal molecular marker annotation by the International Plant Genetic Resources Institute (IPGRI). Raw scoring data will also be available upon request.

Partners recognized for innovation

The CIP-led PRAPACE network and a group of partner organizations working together to improve the lives of refugees in war-torn northern Uganda, where over one million displaced people are living in refugee camps, were among the finalists in the Consultative Group on International Agricultural Research's Innovation Marketplace competition.

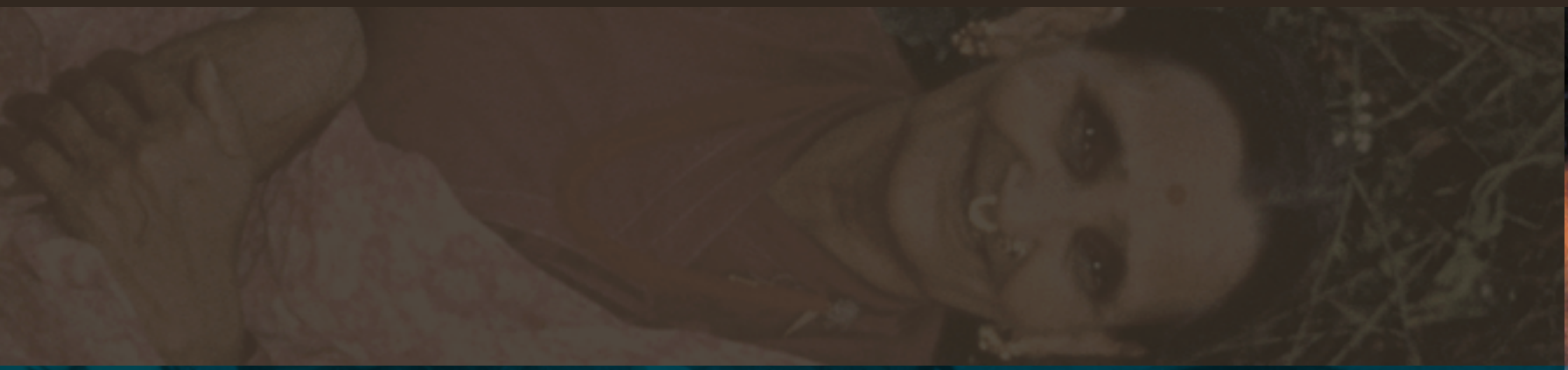
The poster competition, which forms part of the Group's Annual General Meeting, aims to recognize outstanding programs based on their originality, innovativeness, impact, potential to be replicated, and sustainability.

PRAPACE—the Regional Potato and Sweetpotato Improvement Program for Eastern and Central Africa—shared the recognition with the James Arwata Foundation and the Ugandan National Agricultural Research Organization. Together, they presented their work to introduce new high beta-carotene, orange-fleshed sweetpotatoes to provide solutions to the refugees' pressing food, health, and income problems.

Sweetpotato is a sturdy crop that is widely grown in Africa for household consumption. The new orange-fleshed varieties provide a vital source of vitamin A and are also great income generators. Deficiency of vitamin A is one of Africa's most widespread public health problems, particularly among children, pregnant mothers, and HIV/AIDS patients. It can lead to a weakened immune system, blindness, and death.

In addition to disseminating information on the benefits of orange-fleshed sweetpotatoes to researchers and local community members, PRAPACE and its partners are working to boost the distribution of vine cuttings, used as planting material, throughout Uganda's war-torn districts. In just one year, the program has reached over 33,000 people.

As the poster competition demonstrated, this innovative partnership is expected to bring direct benefits to thousands of communities in northern and eastern Uganda, and eventually in neighboring countries facing similar challenges.



CIP IN 2003

From the Board Chair

In 2003 the CIP Board of Trustees monitored and reviewed the Center's program activities, financial procedures and reports, and auditors' reports, and found these to be fully satisfactory. It adopted a risk management framework and reviewed a risk management plan by which the Center identifies, evaluates, and prioritizes risks and opportunities across the organization, and develops risks mitigation strategies. The Board has appointed a risk management committee to provide oversight and report periodically on the implementation of this framework.

Jim Godfrey, CIP Board Chair

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In March 2004, CIP's Board of Trustees chose Pamela Anderson to assume duties as Director General upon the retirement of Dr. Hubert Zandstra at the end of April 2005. Dr. Anderson (USA) joined CIP in June 2002 as Deputy Director General of Research. Since then, she has guided the Center through its visioning and realignment exercise, bringing CIP's research and development program into harmony with the UN Millennium Development Goals and Targets.

DONOR CONTRIBUTIONS

The International Potato Center is grateful for the generous support of all its donors. The funding received helps CIP to develop high quality research and training that helps reduce poverty and achieve food security on a sustained basis in some of the poorest areas of the world. CIP's 2003 revenues were lower than in 2002. To offset the trend of decreasing funding for agricultural research, CIP actively continues to seek new partners and additional sources of funding. CIP has received promising signals that additional funds will be forthcoming in the future, directed to those areas in the world where CIP's work is being targeted to achieve maximum positive impact on the well being of people and the planet.

Donors (ranked by level of contribution) **(US$000)**	**Unrestricted**	**Restricted**[1]	**Total**
Swiss Agency for Development and Cooperation (SDC)	945	1,160	2,105
International Bank for Reconstruction and Development (World Bank Group)	1,262	802	2,064
United States Agency for International Development (USAID)	962	644	1,606
Government of Spain	48	1,501	1,549
Department for International Development (DFID), UK	692	622	1,314
European Commission (EC)		1,254	1,254
Canadian International Development Agency (CIDA)	937	137	1,074
Swedish International Development Cooperation Agency (SIDA)	798	40	838
Government of Netherlands	366	437	803
Government of Austria		555	555
Danish International Development Agency (DANIDA)	448	32	480
Government of Luxembourg		452	452
International Development Research Center (IDRC), Canada		420	420
Government of Germany (BMZ/GTZ)	233	156	389
Australian Centre for International Agricultural Research (ACIAR)	177	155	332
Government of Japan	220	61	281
Government of Norway	278		278
Government of Italy	113	151	264
Global Environmental Facility (GEF)		241	241
United States Agency for International Development (USAID) / International Center for Agricultural Research in Dry Areas (ICARDA)		200	200
Fondo Regional de Tecnología Agropecuaria (FONTAGRO) / Red Internacional de Investigación de Metodología de Investigación de Sistemas de Producción (RIMISP)		159	159
McKnight Foundation		153	153
Government of China	110		110
Government of Belgium	106		106
International Livestock Research Institute (ILRI)		94	94
Centro Internacional de Agricultura Tropical (CIAT)		78	78
CGIAR / International Water Management Institute (IWMI)		70	70
Food and Agriculture Organization of the United Nations (FAO)		60	60
Government of the Republic of Korea	60		60
Government of France	56		56
Swiss Centre for International Agriculture (ZIL)		55	55
Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)		53	53
Government of South Africa	50		50
Government of India	38		38
Government of Islamic Republic of Iran	35		35
International Services for National Agricultural Research (ISNAR)		33	33
Natural Resources Institute (NRI), UK		27	27
Government of Brazil	25		25
Organization of Petroleum Exporting Countries (OPEC) Fund for International Development		21	21
Ministry of Agriculture – Peru		18	18
Servicio Nacional de Sanidad Agraria (SENASA)		13	13
German Agency for Technical Cooperation – GTZ		9	9
Government of Mexico	5		5
United States Department of Agriculture (USDA)		1	1
Total	**7,964**	**9,864**	**17,828**

1 Restricted revenues are recognized if the funds are received and spent. For this reason, some restricted revenues may differ from the amount committed or transferred by donors.

FINANCIAL REPORT

In 2003 the International Potato Center achieved a net surplus of US$ 0.9 million, US$ 0.6 million, or 183 percent above the amount budgeted. The surplus helped to increase the Center's financial reserves.

CIP's total revenues in 2003 were US$18.2 million, 3 percent lower than 2002 revenues. Total revenues included US$7.96 million of unrestricted donations and US$9.86 million of restricted donations. At the end of 2003, US$43 million of grants approved (24 percent of total revenues) had not been released.

CIP's donations are received in US Dollars, Euros, and several other currencies. In 2003, the US dollar continued to depreciate in the currency markets, which created additional revenues of US$ 0.5 million in unrestricted and earmarked activities. Though the US dollar was weak in 2002-2003, it is expected that at some time during 2004 the US dollar will begin to rise, affecting CIP's future revenues denominated in other currencies.

Accumulated expenditures reached US$17.4 million in 2003, 10 percent below the 2002 amount. Expenditures fell in all categories, particularly in services, as well as international and local staff funded by unrestricted donations. This fall was mainly due to a reduction exercise implemented in 2002 and measures taken to improve operational efficiency, which took full effect in 2003. In addition, steps were taken to improve direct and indirect cost recovery from ongoing and new restricted projects, which resulted in an increase from US$0.8 million in 2002 to US$1.3 million in 2003.

By the end of 2003, CIP's financial reserves increased to US$4.5 million. The increase is mainly explained by the 2003 surplus of US$0.9 million, and by the reallocation of US$1.0 million from accruals and provisions to net assets.

In 2003, 72 project proposals for US$41.5 million were submitted to donor agencies. During the year, 52 proposals were approved for total commitments of US$15.1 million. The approved proposals, measured in dollar terms, represent an increase in approved donations of 40 percent compared with 2002. The average donation approved per project climbed from US$0.212 million in 2002 to US$0.29 million in 2003. By the end of the year, the backlog of projects pending approval increased by US$13.6 million to reach US$ 33.1 million.

Austere policies made it possible to keep indirect costs at 13 percent. CIP will continue to exercise prudent management, and indirect costs should decline as the Center expands its research program.

The statement below summarizes CIP's financial position as of December 2003. A copy of the complete audited financial statements may be requested from the office of the Deputy Director General, Corporate Development, at CIP headquarters in Lima, Peru.

Statement of financial position

Year ending 31 December 2003, compared with 2002

	(US$000)	
	2003	**2002**
Assets		
Current assets		
Cash and cash equivalent	9,190	5,969
Accounts receivable:		
Donors	4,268	4,025
Employees	283	311
Others	316	238
Inventories	436	489
Advances	475	432
Prepaid expenses	261	184
Total current assets	15,229	11,648
Property and equipment, net	2,596	2,860
Total assets	**17,825**	**14,508**
Liabilities and net assets		
Current liabilities		
Accounts payable		
Donors	4,290	1,063
Others	6,342	6,709
Accruals	61	1,201
Total current liabilities	10,693	8,973
Net assets		
Appropriated	2,596	3,736
Unappropriated	4,536	1,799
Total net assets	7,132	5,535
Total liabilities and net assets	**17,825**	**14,508**

Realignment of CIP's Research and Development Program

In 2003 CIP completed a Vision exercise that resulted in the prioritization of seven development challenges, which represent eight of the UN's Millennium Development Targets. These challenges can be summarized as: reducing poverty and hunger; improving human health; developing sustainable rural and urban systems; and improving the availability of new technologies. The CIP Vision Plenary concluded that CIP's research and development program can contribute significantly to achieving these Development Targets over the next two decades. The first step taken in moving towards implementation of this vision was a realignment of CIP's program.

Realignment of CIP's Program

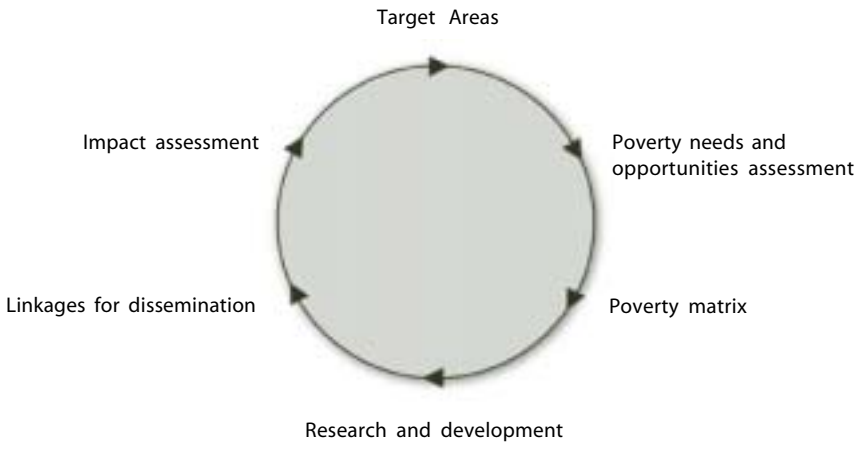
As outlined in Challenge 1 of the CIP Vision (see *www.cipotato.org/cipvision.pdf*), impact assessment studies have documented that improvements in potato and sweetpotato production systems through CIP-related technologies have resulted in significant gains to farm productivity throughout the world, especially in China, India, Central Africa, and the Andean highlands (see *Advanced technologies readied for potato and sweetpotato producers*, page 21). A fundamental objective is to increase the impact of our research across a broader array of challenges, as defined by the Millennium Development Goals and Targets.

In order to enhance impacts on poverty and hunger alleviation, human health, and rural and urban sustainability, the realignment of CIP's Research and Development Program will reflect a pro-poor research and development (R&D) cycle. The cycle starts with impact targeting in order to identify priority areas, populations, and systems where CIP's Program should focus, i.e., where research and development activities should be prioritized.This is followed by participatory needs and opportunity assessments, with anticipated impacts, to shed light on the types of knowledge and technologies that need to be generated or adapted to enhance impact. These analyses will inform the research agenda. Research outputs will then be linked to development partnerships for more efficient and effective dissemination. Impact monitoring and assessment will establish indicators and, through analysis and evaluation, will allow for reorientation or redirection of efforts during the R&D process to maximize the probability of achieving the expected impacts.

In order to make this R&D cycle operative, CIP has realigned its program structure (see next page). Research outputs have been linked to partnership programs for more efficient and effective dissemination. Through this realignment we expect gains in the efficiency, effectiveness, and flexibility of the program.

CIP has a rich and successful history of creating, coordinating, and working in partnerships. Our partners should have a stronger voice in defining national and regional needs and opportunities, and in influencing CIP's research agenda. At the same time it is expected that these needs and opportunities will be increasingly resourced by partnership programs through contract research from the relevant research divisions. Simultaneously, partnership programs

Pro-poor research and development cycle



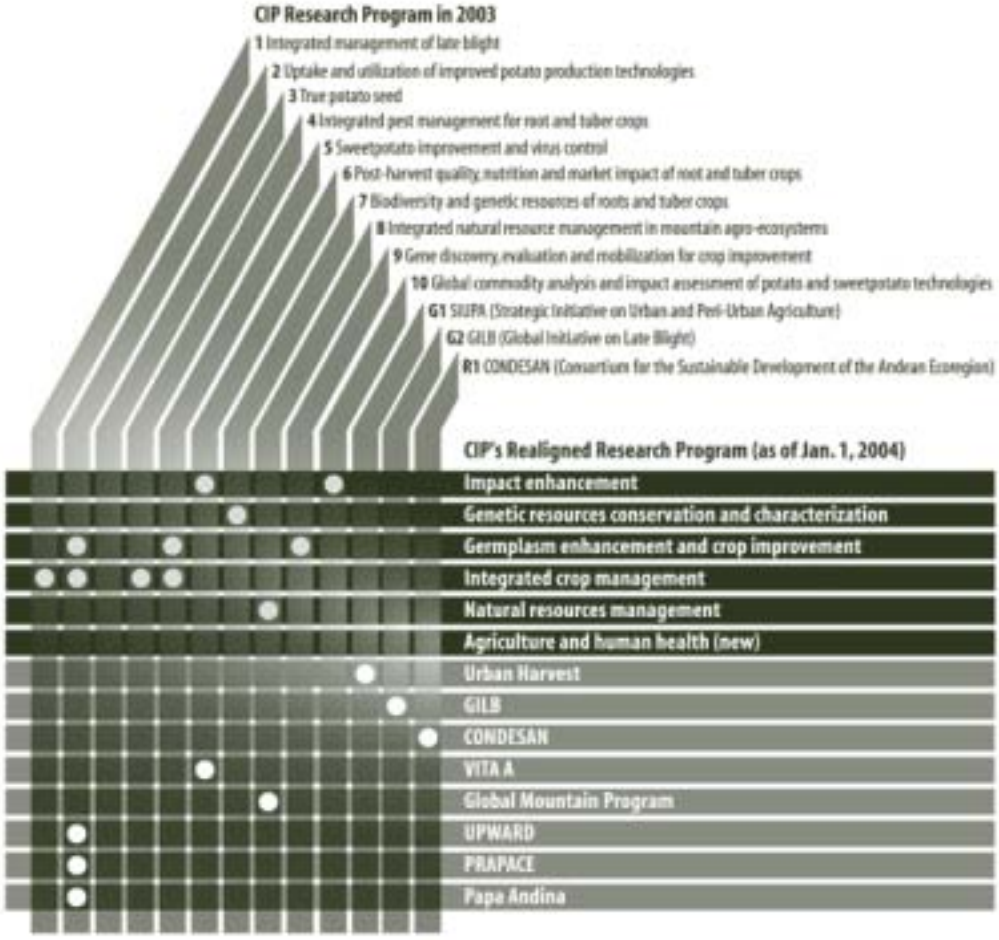
will serve as primary update and utilization platforms for research results, increasing the dissemination and scaling out of the global public goods produced by CIP and enhancing the development impact. The Partnership Programs included in CIP's realigned program structure are coordinated and hosted by CIP; development partnerships will prioritize these highly relevant programs, but not be restricted only to these partnership platforms.

Within the research program, six Research Divisions have been defined. This revised structure should achieve more streamlined research management and be robust enough to persist and maintain its relevance in the face of a dynamic external environment.

New Research Divisions

The Impact Enhancement Division will undertake research to develop improved methodologies for impact targeting and needs/opportunities assessment; adopt and validate a broader conceptual framework for impact assessment; identify impact indicators and methodologies for measuring and monitoring these indicators; and develop strategies and tactics to add value to CIP's commodity research. In essence, this Division will serve

CIP's program structure: In 2003 and as of January 1, 2004



as the compass for the Program, monitoring progress against desired impacts in each of the regional settings and, through research, striving to increase our impact.

The Genetic Resources Conservation and Characterization Division will manage CIP's non-negotiable core responsibility to maintain and characterize the collection of potato, sweetpotato, and Andean root and tuber germplasm that the Center holds in trust. The Germplasm Enhancement and Crop Improvement Division will be responsible for CIP's efforts to better understand and enhance this germplasm for improved crop value. These two Divisions represent CIP's foundation, built and solidified over more than 30 years. They remain critical to enhancing our impact and meeting our challenges.

The remaining three Research Divisions will conduct integration research. The Integrated Crop Management Division will undertake research to integrate solutions to production constraints (e.g. late blight, bacterial wilt, soil degradation) in ways that are appropriate for the region, the target systems, and the socioeconomic constraints of the target populations.

The Natural Resources Management Division will conduct research to improve our understanding of production systems (e.g. potato, sweetpotato) within the complex agro-ecosystems in which they are embedded (e.g. potatoes in highland production systems), and will develop strategies and tactics for intervening in these complex systems that will provide valuable, long-term contributions.

The Agriculture and Human Health Division will carry out research to clarify the linkages among agricultural production, the environment, and human health. Based on the knowledge gathered from this research, intervention strategies will be designed to increase the benefits and mitigate the risks of agricultural production to human health. This exciting new research division will allow CIP to institutionalize and carry forward the innovative research that we have been conducting, and to move beyond compartmentalization of research and development in the fields of agriculture and human health. It will be the first institutionalized program dedicated to agriculture and human health in a CGIAR Center.

Research divisions and their principal activities

1. Impact enhancement
- Characterizing user needs and opportunities for agricultural knowledge and technology
- Assessing dissemination strategies, adoption, and impact
- Adding value to commodities through post-harvest innovations
- Institutional learning for pro-poor impact

2. Genetic resources conservation and characterization
- Collecting and conserving genetic resources
- Assessing genetic resources diversity
- Characterizing genetic resources
- Collaborating on genetic resources policies and capacity building

3. Germplasm enhancement and crop improvement division
- Enhancing potato germplasm and crop improvement
- Enhancing sweetpotato germplasm and crop improvement
- Improving root and tuber crops through transgenics
- Improving adaptation and variety use

4. Integrated crop management
- Integrating management of the potato crop
- Integrating management of the sweetpotato crop

5. Natural resources management
- Characterizing the sustainability of targeted agro-ecosystems
- Examining external disturbances of targeted agro-ecosystems
- Designing and validating resilient agro-ecosystems

6. Agriculture and human health
- Analyzing linkages among production, ecosystems, and human health
- Enhancing human health benefits from agricultural production
- Mitigating human health risks from agricultural production

TRAINING HIGHLIGHTS

CIP's training program is designed to support our mission to contribute to the achievement of healthy and sustainable human development. It focuses on disseminating new and appropriate knowledge and technologies, and on enhancing institutional research skills to improve collaboration in CIP's research agenda. The program also targets farmers in developing countries.

CIP leads training sessions and workshops, organizes and sponsors international conferences, and develops training materials. Participants from more than 30 countries attended the 16 main-group training events conducted across the world in 2003. These activities focused on research methodologies; tools and techniques for developing-country scientists; and on capacity building for sustainable production, targeted at NGOs, government organizations and development agencies. At CIP headquarters, individual training was provided for participants from 10 countries. CIP also supported training in distant locations by distributing publications and manuals, as well as via electronic media, including downloads of manuals, articles, and reports from CIP's training website (*www.cipotato.org/training*), and electronic conferences and workshops. During 2003, CIP successfully completed a distance-learning project with Texas A&M University, USA, to develop a Web-based course on potato seed-tuber production.

CIP continues to develop its website and interactive CD-ROMs to support training organized by CIP headquarters and regional offices, and by CIP-related networks.

Summary of training events

Group training & conferences			Individual Training			Total		
Events (number)	Duration (days)	Participants (number)	Events (number)	Duration (days)	Participants (number)	Events (number)	Duration (days)	Participants (number)
19	110	921	20	721	32	39	831	953

Summary of degree training

M.Sc.			Ph.D.			Interns (B.Sc.)			Total		
Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
4	4	0	2	2	0	138	68	70	144	74	70

Principle group training events

Event (number of participants in parentheses)	External partners	Participating countries
III. International Workshop "Guatemala's potato tuber moth *Tecia solanivora*" (16)	CORPOICA	Bolivia, Colombia, Ecuador, Germany, Venezuela
Workshop "Strategy development for the germplasm homologation of Andean roots and tubers" (5)	PROINPA, INIA Peru, INIAP, UNC	Bolivia, Ecuador, Peru
Workshop "Introduction to the farmers' field schools methodology" (21)	PRONAMACHS	Netherlands, Peru
IPM training course (15)	Ministry of Agriculture, Agriculture Research Center (ARC), Egypt	Egypt

Workshop "Integration of urban agriculture to the sustainable development of the municipalities" (45)	Aguila, UNDP, PGU-ALC, HABITAT, Municipalidad de Lurigancho, Chosica	Cuba, Ecuador, Peru
Course "Participatory improvement and production of decentralized seed of Andean crops" (19)	INIA, Peru	Peru
Potato production course for Asian countries (129)	Rural Development Administration (RDA), Korea	China, Indonesia, Korea, Myanmar, Vietnam
Workshop "Processing and export potential of potatoes within Asia" (300)	Central Potato Research Institute, India	Australia, Bangladesh, Germany, Netherlands, Sri Lanka, Uzbekistan
Workshop "Analysis of the integrated management of the Andean weevil (MIP-GA)" (19)	INIA, SENASA, PRONAMACHS, Peru	Peru
Workshop "Intellectual property and access to genetic resources" (69)	Ministerio de Agricultura, Peru	Canada, Colombia, Indonesia, Peru, Uruguay
Workshop "Research project on climatic variability and family welfare in the Andes" (27)	SENAMHI, UNALM, CIRNMA, PROINPA	Bolivia, Peru, USA,
Seminar "Access to phytogenetic resources in the Andean Region" (43)	Sociedad Peruana de Derecho Ambiental	Argentina, Belgium, Boliva, Colombia, Ecuador, Peru, Spain, Venezuela, USA
Workshop "Auto-evaluation of the collaborative program on ARTCs biodiversity" (18)	INIA Peru, INIAP Ecuador, PROINPA	Bolivia, Colombia, Ecuador, Peru, Switzerland
Workshop "Day of the potato-improver" (12)	INIA, Peru	Peru
Workshop "Strategies for the use of sweetpotato in human and animal nourishment" (25)	FONTAGRO	Argentina, Chile, Dominican Republic, Ecuador, Nicaragua Peru, Venezuela
Training course on potato production (29)	Ministry of Agriculture, Afghanistan	Afghanistan

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CIP'S PARTNERS

AARI Aegean Agricultural Research Institute, Turkey • **AARI** Ayub Agricultural Research Institute, Pakistan • **AAS** Academy of Agricultural Sciences, North Korea • **ACIAR** Australian Centre for International Agricultural Research • **ADB** Asian Development Bank • **ADT** Akukuranut Development Trust, Kenya • **AFRENA** African Resource Network in Agro-Forestry, Uganda • **AFRICARE**, Uganda • **AGERI** Agriculture Genetic Engineering Research Institute, Egypt • **AGES** Austrian Agency for Health and Food Safety • **A**gricultural Research Council, South Africa • **A**gricultural Research Institute, Tanzania • **AHI** African Highland Initiative Program, East Africa • **A**inshams University, Faculty of Agriculture, Egypt • **AIAT-WS** Agricultural Technology Assessment Institute West Sumatra, Indonesia • **AIT** Asian Institute of Technology, Thailand • **A**lemaya University of Agriculture, Ethiopia • **A**lexander von Humboldt Biological Research Institute, Colombia • **A**ngola Seeds of Freedom Project • **A**nhui Academy of Agricultural Science, China • **APPRI** Agricultural Plant Protection Research Institute, Egypt • **APROSEPA** Asociación de Productores de Semilla de Papa, Bolivia • **A**rapai College, Uganda • **ARARIWA** Association for Andean Technical-Cultural Promotion, Peru • **ARC** Agriculture Research Centre, Egypt • **ARC** Agricultural Research Corporation, Sudan • **ARC** Agricultural Research Council, South Africa • **ARC**sr Agriculture Research Centre, Seibersdorf, Austria • **ARDC** Agricultural Research and Development Centre, Uganda • **AREA** Agricultural Research and Extension Authority, Yemen • **ARI** Agricultural Research Institute, Pakistan • **ARI** Agricultural Research Institute, Tanzania • **ARO** Agricultural Research Organization, Israel • **ASAR** Asociación de Servicios Artesanales y Rurales, Bolivia • **ASARECA** Association for Strengthening Agricultural Research in Eastern and Central Africa, Uganda • **ASPADERUC** Asociación para el Desarrollo Rural de Cajamarca, Peru • **ATDTP** Agricultural Technology Development and Transfer Project, Rwanda • **AT**-Uganda Appropriate Technology Uganda • **AVRDC** Asian Vegetable Research and Development Center, Taiwan • **A**wasa Research Centre, Ethiopia • **BADC** Bangladesh Agricultural Development Corporation • **BAR** Bureau of Agricultural Research, Department of Agriculture, Philippines • **BARI** Bangladesh Agricultural Research Institute • **BCNC** Baguio City Nutrition Council, Philippines • **BEAF/GTZ** Beratungsgruppe Entwicklungsorientierte Agrarforschung • **BIOGEN** Biodiversidad y Genética, Peru • **BRAC** Bangladesh Rural Advancement Committee • **BRC** Biotechnology Research Center, Vietnam • **BRRI** Bangladesh Rice Research Institute • **BSU** Benguet State University, Philippines • **BTA** Biotecnología Agropecuaria SA, Chile • **BUCADEF** Buganda Cultural Development Foundation, Uganda • **B**vumbwe Research Station, Malawi • **CAAS** Chinese Academy of Agricultural Sciences • **CAB** International, Kenya • **CAF** College for Agriculture and Forestry, Vietnam • **CAPAC** Cadenas Productivas Agricolas de Calidad, Peru • **CARDI** Caribbean Agricultural Research and Development Institute, Trinidad • **CARE**-Bangladesh • **CARE**-Kenya • **CARE**-Peru • **CARE**-Rwanda • **CASREN** Crop-Animal Systems Research Network • **CAU** China Agricultural University, China • **C**avSU Cavite State University, Philippines • **CBC** Centro Bartolomé de las Casas, Peru • **CCAP** Chinese Center for Agricultural Policy, China • **CECOACAM** Central de Cooperativas Agrarias de Cañete y Mala, Peru • **CEDEPAS** Centro Ecuménico de la Promoción y Acción Social, Peru • **CEMOR** Cemor Editores & Promotores, Peru • **CENA** Civil Engineers Network Africa, South Africa • **C**endrawasih University, Indonesia • **C**entro de Investigación Agrícola Tropical, Bolivia • **C**entro de Investigación en Biotecnología, Costa Rica • **C**entros de Reproducción de Entomógenos y Entomopatógenos, Cuba • **CERGETYR** Centro Regional de Recursos Genéticos de Tuberosas y Raíces, Peru • **CFC** Common Funds for Commodities • **CFH** Conservation, Food and Health Foundation, USA • **C**hiang Mai University, Thailand • **C**hristian AID, DR Congo • **CIAAB** Centro de Investigaciones Agrícolas A. Boerger, Uruguay • **CIAD** Center for Integrated Agricultural Development, China • **CICA** Centro de Investigación en Cultivos Andinos, Peru • **CIDA** Canadian International Development Agency • **CIED** Centro de Investigación, Educación y Desarrollo, Peru • **CIPDER** Consorcio Interinstitucional para el Desarrollo Regional Cajamarca, Peru • **CIRNMA** Centro de Investigación de Recursos Naturales y Medio Ambiente, Peru • **C**ity of Yaounde • **CLADES** Consorcio Latinoamericano de Agroecología y Desarrollo, Peru • **CLSU** Central Luzon State University, Philippines • **CNCQS** Chinese National Centre for Quality Supervision and Test of Feed • **CNPH** Centro Nacional de Pesquisa de Hortaliças, Brazil • **CODESE** Comité de Semilleristas, Peru • **C**omunité de Yaounde, Cameroon • **CONAM** Consejo Nacional del Ambiente, Peru • **CONCYTEC** Consejo Nacional de Ciencia y Tecnología, Peru • **C**onservation, Food and Health Foundation • **C**onsorcio Surandino, Peru • **COPASA** Cooperación Peruano Alemana de Seguridad Alimentaria, Peru • **CORPOICA** Corporación del Instituto Colombiano Agropecuario, Colombia • **CPPS** Chongqing Plant Protection Station, China • **CPRA** Centre de perfectionnement et de recyclage agricole de Saïda, Tunisia • **CPRI** Central Potato Research Institute, India • **CPRS** Central Potato Research Station, India • **CRIBA** Centro Regional de Investigación en Biodiversidad Andina, Peru • **CRIFC** Central Research Institute for Food Crops, Indonesia • **CRIH** Central Research Institute for Horticulture, Indonesia • **CRP**-Gabriel Lippmann,

Luxembourg • **CRS** Catholic Relief Services, Kenya, Uganda, Sudan, Indonesia • **CTCRI** Central Tuber Crops Research Institute, India • **DAE** Department of Agricultural Extension, Bangladesh • **DANIDA** Danish International Development Agency • **DARHRD** Department of Agricultural Research and Human Resource Development, Eritrea • **D**epartment of Agriculture, Nepal • **D**epartment of Agriculture, Philippines • **D**epartment of Agriculture, Thailand • **D**epartment of Agriculture, Phichit Horticultural Research Center, Thailand • **DFID** Department for International Development • **DGIS** Directorate-General for International Cooperation, Netherlands • **DINAREN** Dirección Nacional de Recursos Naturales Renovables, Ecuador • **D**inas Peternakan Wamena, Indonesia • **D**irección Nacional de Sanidad Vegetal, Cuba • **D**irectorate of Root Crop Production, Ministry of Agriculture, Indonesia • **DPP** Department of Plant Protection, Ministry of Agriculture and Rural Development, Vietnam • **DPRK AAS** Academy of Agricultural Sciences of the DPRK • **DRCFC** Dalat Research Center for Food Crops, Vietnam • **DRDS** Department of Research and Development Services, Bhutan • **DRUK** Seed Corporation of Bhutan • **EARO** Ethiopian Agricultural Research Organization (formerly IAR), Ethiopia • **EARRNET** Eastern Africa Root Crops Research Network, Uganda • **EC** European Commission • **ECABREN** Eastern and Central Africa Bean Research Network, Uganda • **ECAPAPA** Eastern and Central Africa Programme for Agricultural Policy Analysis • **E**coCiencia, Ecuador • **EMBRAPA** Empresa Brasileira de Pesquisa Agropecuária, Brazil • **E**mpresas de Cultivos Varios del Ministerio de Agricultura, Cuba • **ESH** Ecole supérieure d'horticulture, Tunisia • **ETH** Swiss Federal Institute of Technology Zurich • **FAO** Food and Agriculture Organization of The United Nations • **FAO** Community IPM Program, Vietnam and Indonesia • **FAPESP** Fundação de Amparo à Pesquisa do Estado de São Paulo, Brazil • **FCRI** Food Crops Research Institute, Vietnam • **FDR** Fundación para el Desarrollo Rural, Peru • **FIELD** Farmer Initiatives for Ecological Livelihood and Democracy, Indonesia • **FOFIFA/FIFAMANOR** Centre national de la recherche appliquée au développement rural, Madagascar • **F**ood Crop Research Institute, Vietnam • **FONTAGRO/RIMISP** Fondo Regional de Tecnología Agropecuaria/Red Internacional de Metodología de Investigación de Sistemas de Producción • **FOODNET** (ASARECA network implemented by IITA) • **FORTIPAPA** Fortalecimiento de la Investigación y Producción de Semilla de Papa, Ecuador • **FOVIDA** Fomenta de la Vida, Peru • **FSP** Forages for Smallholders Project, CIAT, Colombia • **FUNDAGRO** Fundación para el Desarrollo Agropecuario, Ecuador • **FUNDANDES** Fundación para el Ambiente Natural y el Desarrollo, Argentina • **GAAS** Guangdong Academy of Agricultural Sciences, China • **GEF** Global Environment Facility • **GILB** Global Initiative on Late Blight, Peru • **GKF** Grameen Krishi Foundation, Bangladesh • **G**overnment of Belgium • **G**overnment of China • **G**overnment of Denmark • **G**overnment of Germany • **G**overnment of India • **G**overnment of Mexico • **G**overnment of Norway • **G**overnment of Peru • **G**overnment of South Africa • **G**overnment of Spain • **G**overnment of the Islamic Republic of Iran • **G**overnment of Luxembourg • **G**overnment of the Netherlands • **G**overnment of the Republic of Korea • **G**overnment of South Africa • **G**overnment of Spain • **GTZ** Deutsche Gesellschaft fur Technishce Zusammenarbeit • **HAAS** Heilongjiang Academy of Agricultural Sciences, China • **HARI** Humeng Agricultural Research Institute, China • **HAU** Hanoi Agriculture University, Vietnam • **H**ong Doc University, Vietnam • **H**ong Kong University, China • **HORDI**, Horticultural Research and Development **I**nstitute, Sri Lanka • **HRI** Horticulture Research Institute, Egypt • **HUAF** Hue University for Agriculture and Forestry, Vietnam • **H**uanzhong Agricultural University, China • **H**ubei Agricultural University, China • **H**ung Loc Agriculture Research Center, Vietnam • **H**asanuddin University, Indonesia • **IAI-ISP** Inter-American Institute for Global Change Research, Initial Science Program, Brazil • **IAN** Instituto Agronómico Nacional, Paraguay • **IAS** Institute of Agricultural Sciences, Ministry of Agriculture and Rural Development, Vietnam • **IASA** Instituto Agropecuario Superior Andino, Ecuador • **IAV** Institut agronomique et vétérinaire Hassan II, Morocco • **ICA** Instituto Colombiana Agropecuaria, Colombia • **ICAR** Indian Council of Agricultural Research, India • **ICO CEDEC** Instituto de Capacitación del Oriente, Bolivia • **IDEA** Instituto Internacional de Estudios Avanzados, Venezuela • **IDIAP** Instituto de Investigación Agropecuaria de Panamá, Panama • **IDRC** International Development Research Centre • **IEBR** Institute of Ecology and Biological Resources, Vietnam • **IESR/INTA** Instituto de Economía y Sociología Rural del INTA, Argentina • **IFAD** International Fund for Agriculture Development • **IIN** Instituto de Investigación Nutricional, Peru • **IIRR** International Institute of Rural Reconstruction, Philippines • **IMA** Instituto de Manejo de Agua y Medio Ambiente, Peru • **INAMHI** Instituto Nacional de Meteorología e Hidrología, Ecuador • **INCAGRO** Innovación y Competitividad para el Agro Peruano, Peru • **INERA**, Institut nationale d'études et de recherches agricoles, DR Congo • **INIA** Instituto Nacional de Investigacão Agronómica, Mozambique • **INIA** Instituto Nacional de Investigación Agraria, Peru • **INIA** Instituto Nacional de Investigaciones Agropecuarias, Chile • **INIA** Instituto Nacional de Investigaciones Agropecuarias, Uruguay • **INIA** Instituto Nacional de Investigaciones Agrícolas, Venezuela • **INIAP** Instituto Nacional de

Investigaciones Agropecuarias, Ecuador • **INIFAP** Instituto Nacional de Investigaciones Forestales y Agropecuarias, Mexico • **INIVIT** Instituto Nacional de Investigación de Viandas Tropicales, Cuba • **INPOFOS** Instituto de la Potasa y el Fósforo, Ecuador • **INRA** Institut national de la recherche agronomique, France • **INRA** Institut national de la recherche agronomique, Morocco • **INRAT** Institut national de la recherche agronomique de Tunisie, Tunisia • **I**nstituto Rural Valle Grande, Cañete, Peru • **INTA** Instituto Nacional de Tecnología Agropecuaria, Argentina • **IPAC** Instituto de Promoción Agropecuaria y Comunal, Peru • **IPB** Institut Pertanian Bogor Indonesia • **IPDA** Instituto de Promoción y Desarrollo Agrario, Peru • **IRA** Institut de recherche agronomique, Cameroon • **IRAD** Institut de recherche agricole pour le développement, Cameroon • **IRD** Institut de recherche pour le développement, France • **ISABU** Institut des sciences agronomiques du Burundi • **ISAR** Institut des sciences agronomiques du Rwanda • **ISTPC** Instituto Superior Tecnológico Público de Cañete, Peru • **JAAS** Jiangsu Academy of Agricultural Sciences, China • **J**erusalen de Porcon Cooperative, Peru • **JKUAT** Jomo Kenyatta University of Agriculture and Technology, Kenya • **JTTK** Jaringan Tani Tanah Karo, Indonesia • **KARI** Kenyan Agricultural Research Institute • **K**augu & Katheri Farmers, Kenya • **KEPHIS** Kenya Plant Health Inspectorate Service • **L**a Habana University, Chemistry Faculty, Cuba • **L**ake Basin Development Authority, Kenya • **LDI** Landscape Development Intervention, Madagascar • **L**ucana, Bolivia • **M**akerere University, Uganda • **MANRECUR** Manejo Colaborativo de Recursos Naturales en la Subcuenca del Río el Angel, Ecuador • **MARDI** Malaysia Agriculture Research Development Institute, Malaysia • **MARS** Mwara Agricultural Research Institute, • **M**ianning Agriculture Bureau, China • **M**inisterio de Agricultura, Peru • **M**inisterio Presidencia, Peru • **M**inisterio Relaciones Exteriores, Peru • **M**inistry of Agriculture, China • **M**inistry of Agriculture, Ecuador • **M**inistry of Agriculture, Eritrea • **M**inistry of Agriculture and Cooperatives, Division of Research and Development, Tanzania • **M**inistry of Agriculture and Land Reclamation, Egypt • **MIP** Programa de Manejo Integrado de Plagas, Dominican Republic • **M**itra Tani, Indonesia • **MMSU** Mariano Marcos State University, Philippines • **M**ontana State University, USA • **MPIZ** Max Planck Institute for Plant Breeding Research • **MSIRI** Mauritius Sugar Industry Research Institute • **M**unicipalidad Distrital Baños del Inca Peru • **NAARI** Namulonge Agricultural and Animal Research Institute, Uganda • **N**anchong Agricultural Research Institute, China • **NARC** National Agricultural Research Centre, Pakistan • **NARC** Nepal Agricultural Research Council • **NARO** National Agricultural Research Organization, Uganda • **N**atural Resources Institute, United Kingdom • **NCVESC** National Center for Variety Evaluation and Seed Certification, Vietnam • **NEPAD** New Partnership for Africa's Development • **NIAH** National Institute of Animal Husbandry, Vietnam • **N**jabini Farmer Group, Kenya • **N**kozi University, Uganda • **NOMIARC** Northern Mindanao Agricultural Research Center, Philippines • **N**omorionteetab Kibagenge, Kenya • **NPRCRTC** Northern Philippines Root Crops Research and Training Center, Philippines • **NPRC** National Potato Research Centre Tigoni, Kenya • **NPRP** National Potato Research Program, Nepal • **NUS** National University of Singapore • **ODER** Oficina de Desarrollo Rural–Chalaco, Peru • **ORS** Oficina Regional de Semillas, Bolivia • **PCARRD** Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Philippines • **PDL** Proyecto Desarrollo Lechero, Bolivia • **PDP** Potato Development Program, Nepal • **REDCAPAPA** Red Estratégica para el Desarrollo de Cadena Agroalimentaria de la Papa, Ecuador • **P**hilippine Root Crops Research and Training Center • **PIA** Programa de Investigación Agropecuaria, Bolivia • **PICA** Programa de Investigación de Cultivos Andinos, Peru • **PICTIPAPA** Programa Internacional de Cooperación del Tizón Tardío de la Papa, Mexico • **P**lan International, Kenya • **PNS-PRODISE** Programa Nacional de Semillas del Proyecto de Desarrollo Integral de Semillas, Peru • **P**ontificia Universidad Católica del Ecuador • **PPD** Plant Protection Department, Ministry of Agriculture and Rural Development, Vietnam • **PPRI** Plant Pathology Research Institute, Egypt • **PRAPACE** Programme régional de l'amélioration de la culture de la pomme de terre et de la patate douce en Afrique centrale et de l'est • **PRCRTC**, Philippine Root Crop Research and Training Center • **PRECODEPA** Programa Regional Cooperativo de Papa, Mexico • **PREDUZA** Proyecto de Mejoramiento para Resistencia Duradera en Cultivos Altos en la Zona Andina, Ecuador • **PROINPA** Fundación para la Promoción e Investigación de Productos Andinos, Bolivia • **PROMETAS** Promoción y Mercadeo de Tubérculos Andinos, Universidad Mayor de San Simón, Bolivia • **PROMSA** Programa de Modernización de Servicios Agropecuarios, Ecuador • **PRONAMACHCS** Proyecto Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos, Peru • **PROSHIKA**, A Centre for Human Development, Bangladesh • **PRP** Potato Research Programme, Nepal • **RANTIK** Ltd, Bangladesh • **RAU** Rajendra Agricultural University, Bangladesh • **RDA** Rural Development Agency, Republic of Korea • **RDRS** Rangpur Dinajpur Rural Society, Bangladesh • **REFSO** Rural Energy and Food Security Organization, Kenya • **R**egional Agricultural Research and Development Centre, Sri Lanka • **RIAP** Research Institute for Animal Production, Indonesia • **RIFAV** Research Institute for Fruits and Vegetables, Vietnam • **RIFCB** Research Institute for Food Crops Biotechnology, Indonesia • **RILET** Research Institute for Legume and Tuber

Crops, Indonesia • **RIV** Research Institute for Vegetables, (formerly LEHRI), Indonesia • **RCRC–VASI** Root Crop Research Center, Vietnam Agricultural Science Institute • **RNC-RC** Jakar, Bhutan • **R**ockefeller Foundation • **SAAS** Shangdong Academy of Agricultural Sciences, China • **SARDI** South Australian Research Development Institute • **SARDI–UMCOR** Sustainable Agricultural and Rural Development Initiative–United Methodist Committee on Relief, DR Congo • **SARIF** Sukamandi Research Institute for Food Crops, Indonesia • **SARRNET** Southern Africa Root Crops Research Network • **S**asakawa-Global 2000, Ethiopia • **S**ave the Children (UK Ltd), Ethiopia • **SCRI** Scottish Crop Research Institute • **SDC** Swiss Agency for Development and Cooperation • **SEAG** Servicio de Extensión Agrícola y Ganadera, Paraguay • **SEARCA** Southeast Asian Ministers of Education Organization (SEAMEO) Regional Center for Graduate Study and Research in Agriculture, Philippines • **SEMTA** Servicios Múltiples de Tecnologías Apropiadas, Bolivia • **SENASA** Servicio Nacional de Sanidad Agraria, Peru • **SENASAG** Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria, Bolivia • **SENASEM** Service national de semences, DR Congo • **SEPA** Unidad de Producción de Semilla de Papa, Bolivia • **SESA** Servicio Ecuatoriano de Sanidad Agropecuaria, Ecuador • **ShAAS** Shandong Academy of Agricultural Sciences, China • **SHDI** Self-Help Development International, Ethiopia • **SiAAS** Sichuan Academy of Agricultural Sciences, China • **SIDA** Swedish International Development Cooperation Agency • **SINITTA** Sistema Nacional de Investigación y Transferencia de Tecnología Agraria, Peru • **SITIOS** Servicios Inteligentes y Tecnologías Complejas Superiores Ltd, Bolivia • **SLART** Sociedad Latinoamericano de Raíces y Tubérculos, Peru • **SNSA** Service national des statistiques agricoles, DR Congo • **SOCADIDO** Soroti Catholic Diocese Development Organization, Uganda • **S**okoine University of Agriculture, Tanzania • **S**outh China Agricultural University • **S**outh China Potato Center • **S**outhern Regional Agricultural Bureau, Ministry of Agriculture, Ethiopia • **S**outhwest Agricultural University, China • **SPDA** Sociedad Peruana de Derecho Ambiental • **SPG** Sociedad Peruana de Genética, Peru • **SPPC** Seed Potato Production Center, Yemen • **S**ukarami Agricultural Technology Assessment Institute, Indonesia • **TAAS** Tianjing Academy of Agricultural Sciences, China • **TALPUY** Grupo de Investigación y Desarrollo de Ciencias y Tecnología Andina, Peru • **TARI** Taiwan Agricultural Research Institute • **TCA** Tarlac College of Agriculture, Philippines • **TCRC** Tuber Crops Research Centre, Bangladesh • **T**eso Community Development Project, Kenya • **TFNC** Tanzania Food and Nutrition Centre • **T**hai Nguyen University, Vietnam • **T**hang Binh District Agriculture and Rural Development Bureau, Vietnam • **T**he International Foundation • **T**he McKnight Foundation • **T**he Micronutrient Initiative, Canada • **T**he Mountain Institute, Peru • **T**he OPEC Fund for International Development, Austria • **T**he Senior Family Fund, USA • **T**ibetan Academy of Agricultural and Animal Science, China • **TP4** Tim Petani Pemandu PHT Pengalengan, Indonesia • **UANRDEN** Urban Agriculture National Research, Development and Extension Network, Philippines • **U**gunja Community Resource Centre, Kenya • **UNEP** United Nations Environment Programme • **UNHAS** Hasanudin University, Indonesia • Universidad Austral, Chile • **U**niversidad Nacional de Cajamarca, Peru • **U**niversidad Católica de Santa Maria, Peru • **U**niversidad Central, Ecuador • **U**niversidad Central de las Villas, Cuba • **U**niversidad de Ambato, Ecuador • **U**niversidad de Caldas, Colombia • **U**niversidad de los Andes, Venezuela • **U**niversidad Federal Rio de Janeiro, Brazil • **U**niversidad Jorge Basadre Grohmann de Tacna, Peru • **U**niversidad Jujuy, Argentina • **U**niversidad Mayor de San Simón, Bolivia • **U**niversidad Nacional Agraria, Peru • **U**niversidad Nacional Daniel Alcides Carrión, Peru • **U**niversidad Nacional de Bogotá, Colombia • **U**niversidad Nacional de Cajamarca, Peru • **U**niversidad Nacional del Centro del Perú, Peru • **U**niversidad Nacional Hermilio Valdizán, Peru • **U**niversidad Nacional Mayor de San Marcos, Peru • **U**niversidad Nacional San Antonio Abad de Cuzco, Peru • **U**niversidad Nacional San Cristóbal de Huamanga de Ayacucho, Peru • **U**niversidad Peruana Cayetano Heredia, Peru • **U**niversidad Politécnica del Ejército, Ecuador • **U**niversidad Privada Huánuco, Peru • **U**niversidad Ricardo Palma, Peru • **U**niversidad San Luis Gonzaga de Ica, Peru • **U**niversidad Tecnológica Equinoccial, Ecuador • **U**niversity of Amsterdam, Netherlands • **U**niversity of Asmara, Eritrea • **U**niversity of Idaho, USA • **U**niversity of the Philippines–Los Baños • **U**niversity of Tübigen, Germany • **U**niversity of Wisconsin, USA • **U**niversity of Yaounde, Cameroon • **UNSPPA** Uganda National Seed Potato Producers' Association, Uganda • **UPM** University Putra Malaysia • **USAID** United States Agency for International Development • **VASI** Vietnam Agricultural Science Institute • **VECO/FADO**, Indonesia • **V**ietnamese–German Technical Cooperation Potato Promotion Project • **V**irus-free Potato Tubers and Cutting Production Centers of Yunnan Agricultural Department, China • **VISCA** Visayas State College of Agriculture, Philippines • **VSSP** Vegetable Seed and Seed Potato, Pakistan • **W**allace Genetic Foundation, Inc., USA • **W**ageningen University, Netherlands • **W**inrock International, Uganda • **W**orld Bank • **W**orld Vision, Angola, Burundi, Kenya, Rwanda, Uganda • **WRC** Wheat Research Centre, Bangladesh • **XSPRC** Xuzhou Sweet Potato Research Center, China • **YPPP** Yemeni Plant Protection Project • **YPPSE** Foundation for Socio-Economic Development, Indonesia • **Y**unnan Agricultural University, China • **ZIL** Swiss Centre for International Agriculture

STAFF

In 2003, CIP made a substantial effort to strengthen scientific capacity. This was accomplished by hiring experienced international scientists for key positions, as well as young international scientists through Junior Professional or Associate Professional Programs. New staff also joined the Center through specially funded projects. At the same time, as a result of the recently completed visioning and program realignment, several changes in staff responsibilities were made in 2003. The research program now comprises Research Divisions and Partnership Programs. CIP's staff is a diverse group of highly qualified individuals with varied backgrounds and nationalities. This diversity is integrated into a coordinated effort to achieve a common goal: alleviate poverty and increase food security while protecting the earth's natural resource base. Each and every one of CIP's more than 400 employees worldwide—from scientists to clerical staff to field workers—contributes to this mission through their various functions, and each is an essential part of CIP's working team. Because of space, we are not able to list all names in this Annual Report; nevertheless, we do recognize and greatly appreciate the efforts of all our staff.

DIRECTOR GENERAL'S OFFICE

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Gladys Neyra, Administrative Assistant
Deputy Director General for Corporate Development—Hector Hugo Li Pun
Amalia Lanatta, Administrative Assistant
María Inés Ríos, Business Development Associate[3]
Ana María Secada, Head, Travel Office
Haydée Zelaya, Administrative Assistant
Deputy Director General for Research—Pamela Anderson
Carmen Dyer, Administrative Assistant
Bertha Ferreyros, Information System Analyst
Charlotte Lizárraga, Plant Pathologist, Assistant Coordinator, GILB
Lilia Salinas, Administrative Assistant
Director, International Cooperation[5]—Roger Cortbaoui
Rosario Marcovich, Administrative Assistant

FINANCE AND ADMINISTRATION

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Lucas Reaño, Human Resources Manager
Mónica Ferreyros, Auxiliary Services Supervisor
Sor Lapouble, Auxiliary Services Assistant
Gicela Olivera, Organization and Methods Assistant
Martha Piérola, Social Worker, Supervisor
William Polo, Compensation and Benefits Assistant
Lucero Schmidt, Nurse
María Amelia Távara, Bilingual Secretary
Yoner Varas, Compensation and Benefits Assistant
Juana Zamudio, Auxiliary Services Assistant
Logistics and General Services
Aldo Tang, Logistics and General Services Manager
Pilar Bernui, Bilingual Secretary
Silvia Córdova, Bilingual Secretary
Hugo Davis, Vehicle Maintenance Officer
Ximena Ganoza, Purchasing Supervisor
Atilio Guerrero, Vehicle Programmer
Jorge Locatelli, Security Supervisor
Jorge Luque, Warehouse Supervisor
Antonio Morillo, Maintenance Supervisor
Gloria Solís, Administrative Assistant

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Martina Solís-Rosas, Bilingual Secretary
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Miguel Saavedra, General Accountant
Edgardo de los Ríos, Senior Accountant
Andrés García, Assistant Accountant
Denise Giacoma, Supervisor
Rodmel Guzmán, Assistant Accountant
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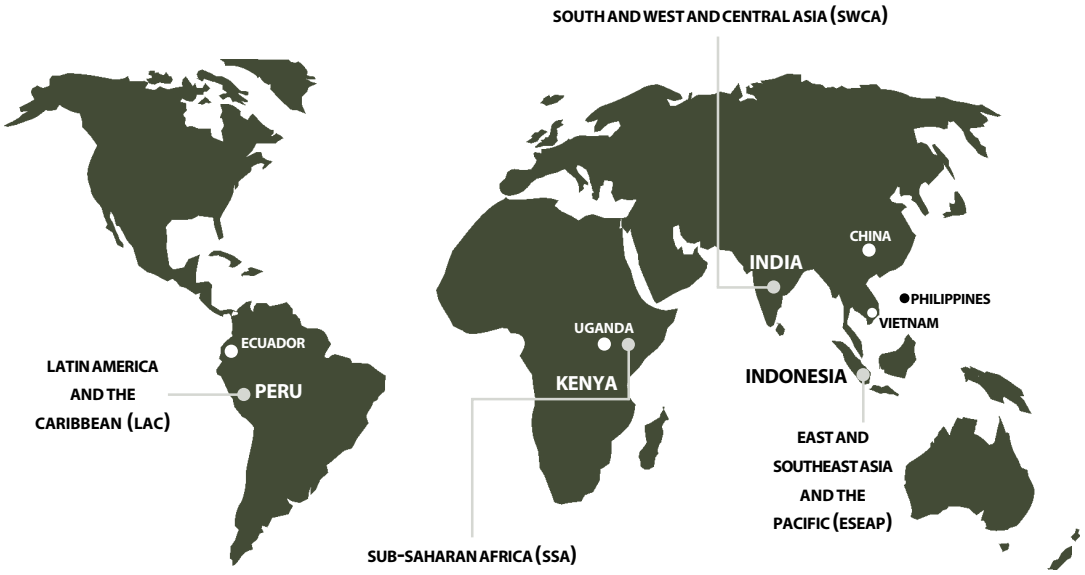

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CIP is one of 15 food and environmental research centers located around the world that make up the Future Harvest Alliance. The Future Harvest Centers receive their principal funding through the Consultative Group on International Agricultural Research (CGIAR), a strategic global partnership of countries, international and regional organizations, and private foundations. Working with national agricultural research systems, the private sector and civil society, the CGIAR mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth, and protect the environment.

The Centers collaborate among themselves and with their diverse partners through numerous projects and system-wide programs. The CGIAR is also creating a series of independently governed partnerships among a wide range of institutions for high-impact research that targets complex issues of overwhelming global and/or regional significance. CIP has substantial participation in each of these Challenge Programs, and intends to extend this involvement to the Sub-Saharan Africa Challenge Program, currently being formulated. Over the past two years, three Challenge Programs have been established:

The Challenge Program on Water and Food creates research-based knowledge and methods for growing more food with less water.

The HarvestPlus Challenge Program reduces micronutrient malnutrition by harnessing the powers of agriculture and nutrition research to breed nutrient-dense staple foods.

The Generation Challenge Program (Unlocking Genetic Diversity in Crops for the Resource-Poor) uses advances in molecular biology and harnesses the rich global stocks of crop genetic resources to create and provide a new generation of plants that meet the specific problems and needs of resource-poor people who rely on agriculture for subsistence and their livelihoods.

For more information, see: *www.cgiar.org* • *www.futureharvest.org* • *www.waterforfood.org* • *www.harvestplus.org* • *www.generationcp.org*

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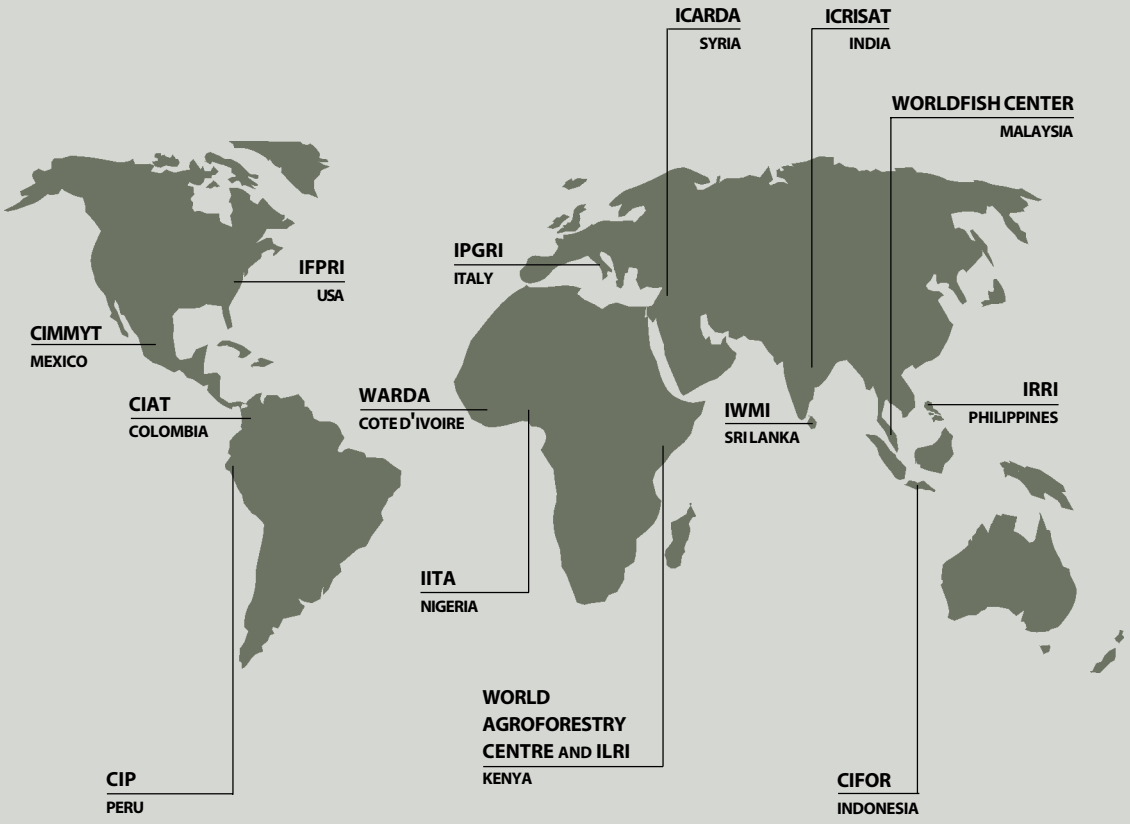

CIAT **C**entro Internacional de Agricultura Tropical

CIFOR **C**enter for International Forestry Research

CIMMYT **C**entro Internacional de Mejoramiento de Maíz y Trigo

CIP **C**entro Internacional de la Papa

ICARDA **I**nternational Center for Agricultural Research in the Dry Areas

ICRISAT **I**nternational Crops Research Institute for the Semi-Arid Tropics

IFPRI **I**nternational Food Policy Research Institute

IITA **I**nternational Institute of Tropical Agriculture

ILRI **I**nternational Livestock Research Institute

IPGRI **I**nternational Plant Genetic Resources Institute

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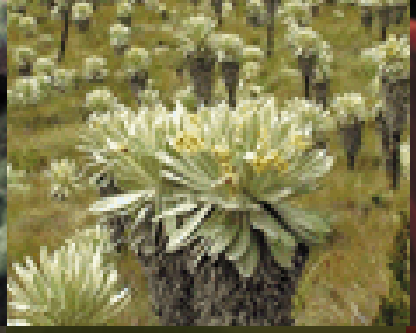


The International Potato Center (CIP) seeks to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweetpotato, and other root and tuber crops, and on the improved management of natural resources in the Andes and other mountain areas.

The CIP Vision

The International Potato Center (CIP) will contribute to reducing poverty and hunger; improving human health; developing resilient, sustainable rural and urban livelihood systems; and improving access to the benefits of new and appropriate knowledge and technologies. CIP, a World Center, will address these challenges by convening and conducting research and supporting partnerships on root and tuber crops and on natural resources management in mountain systems and other less-favored areas where CIP can contribute to the achievement of healthy and sustainable human development.

www.cipotato.org

CIP is a Future Harvest Center and receives its principal funding from a group of governments, private foundations, and international and regional organizations known as the Consultative Group on International Agricultural Research (CGIAR).

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