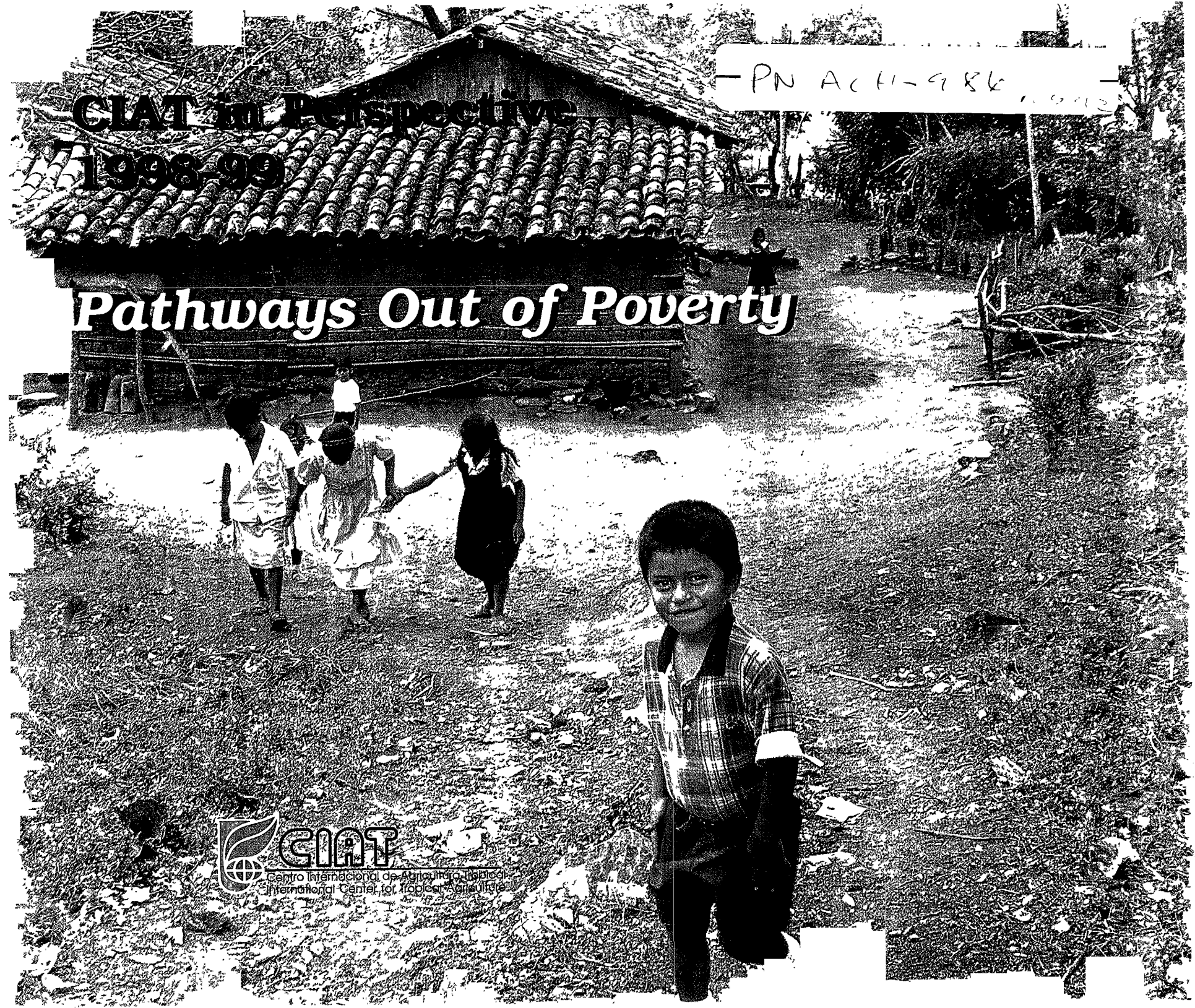
CIAT in Perspective 1998-99

Pathways Out of Poverty



CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

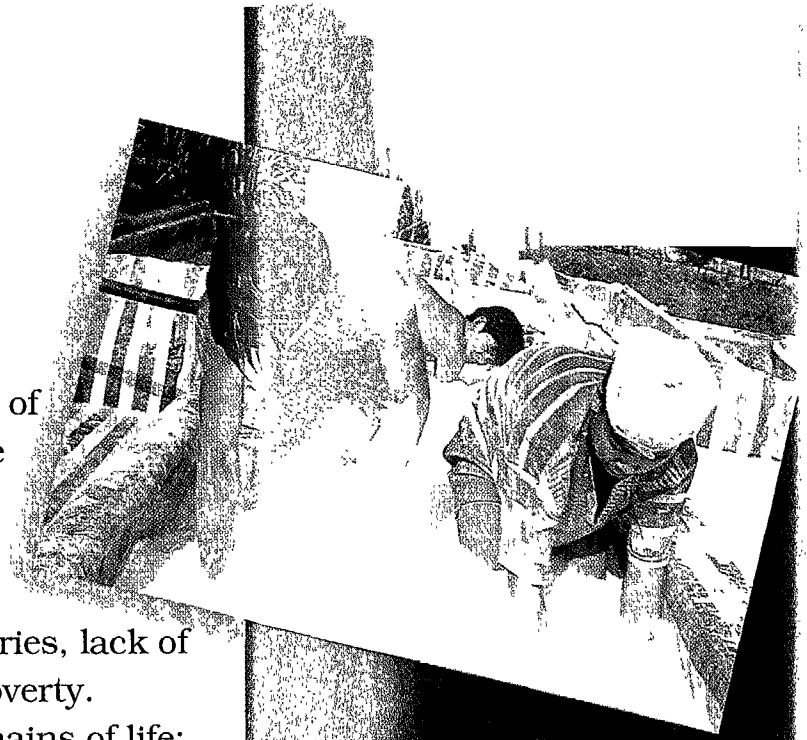
On the way home in Colonia Berlin, Santa Cruz, Bolivia

Perspective in Practice

Poverty is a word that sends shivers through the rich and moderately well-off. It conjures up thoughts of dwindling bank accounts, deferred vacations, feeble retirement incomes. But the shivers are usually quelled by well-rehearsed hope.

For millions of small farmers in the developing countries, lack of cash is but one burden in the daily reality of poverty. Deprivations reinforce each other in many other domains of life: nutrition, longevity, freedom, political power, access to education and health services, and a safe physical environment. These are a few of the strands in the complex web of human impoverishment. In these circumstances it is hard for hope to spring eternal.

This annual report of the International Center for Tropical Agriculture (CIAT) describes a mix of people-centered solutions—for producing food, managing natural resources, improving incomes, and otherwise empowering rural communities. Pathways out of poverty do exist. And each set of footprints on them encourages more people to follow.



"Poverty is not to be suffered in silence by the poor. Nor can it be tolerated by those with the power to change it. The challenge is now to mobilize action."

James Gustave Speth
Formerly Administrator, United Nations Development Programme

Pathways Out of Poverty

Director general's message

In reviewing progress to reduce poverty and in charting our course for the coming years, it is instructive to recall the origins of CIAT and other centers of the Consultative Group on International Agricultural Research (CGIAR). Four decades ago, world food problems were extremely serious, with famine crippling some nations. Alarmingly high rates of population growth were putting intense pressure on global food supplies.

A handful of insightful people at the Ford and Rockefeller Foundations felt a new approach was needed. They began with the assumption that science had much to contribute. They believed a concerted and sustained research effort, based not in the USA or Europe or Australia, but in developing countries with national partner cooperation, was the way ahead.

Making food more affordable

History confirms the acuity of their vision: the Green Revolution was a roaring success. The value of production gains, especially in cereals, cannot be overemphasized. Two billion more people now live on our planet than when these bold, new scientific efforts began. Yet food production has more than kept up with population growth.

Unashamedly, the goal was to increase "the pile of food." That was what the international agricultural research centers were all about. But they also contributed enormously to reducing poverty, even though that was not an explicit aim.

Rice research provides a good example. As an economist working with CIAT back in the 1970s, I looked at the impact of Green Revolution technology in Latin America. The story is remarkable: total rice production more than doubled from the mid-1960s to the mid-1990s, mainly as a result of increased yields in irrigated production.

Transportation of a rice harvest at Saldaña, Tolima Department, Colombia.

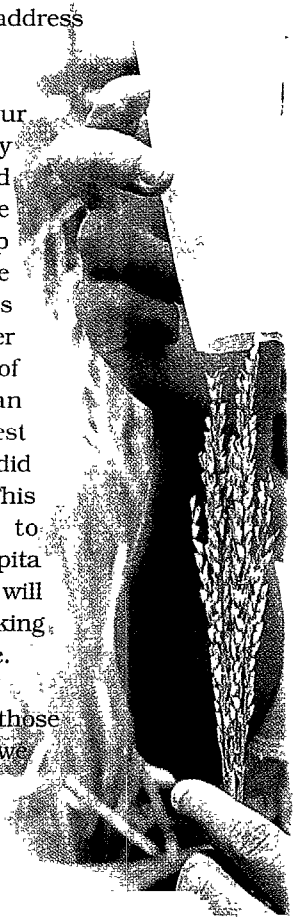
With more efficient production, rice prices in real terms have dropped by about half over the past three decades in Latin America. The link with poverty alleviation, at least the economic component, is obvious. Even modest price reductions are a boon to low-income families in Latin America, who may spend as much as half of their income on food and about 15 percent of that on rice alone.

Production and beyond

In the 1990s, the CGIAR refined its goals to explicitly focus on poverty alleviation and the sustainable use of natural resources. How do we now address these?

First, we cannot forget our history. It is still absolutely vital to increase food production. If we do not, the real price of food will go up and hurt the poor. A simple but startling fact illustrates the production challenge. Over the next 50 years, a blink of the eye in terms of human history, the world must harvest about as much food as it did over the past 12 millennia. This is what is needed just to maintain our current per capita supply. And the production will have to come from a shrinking global natural resource base.

Second, to avoid mining those resources out of existence, we



need to find sustainable farming methods and social arrangements for introducing them successfully. This is especially important for poor farmers working in marginal areas under tough growing conditions.

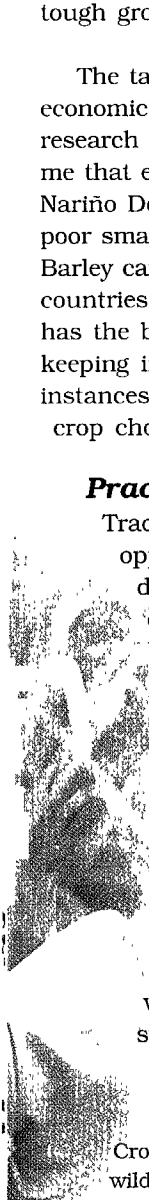
The task is complicated by changing economic patterns, especially in world trade. A research leader here in Colombia recently told me that even a tripling of barley production in Nariño Department would not be enough for poor small farmers to earn a decent living. Barley can be produced more cheaply in other countries. So, while international competition has the benefit of boosting efficiency and keeping international food prices low, in some instances it will require major shifts in farmers' crop choices.

Practical solutions for the poor

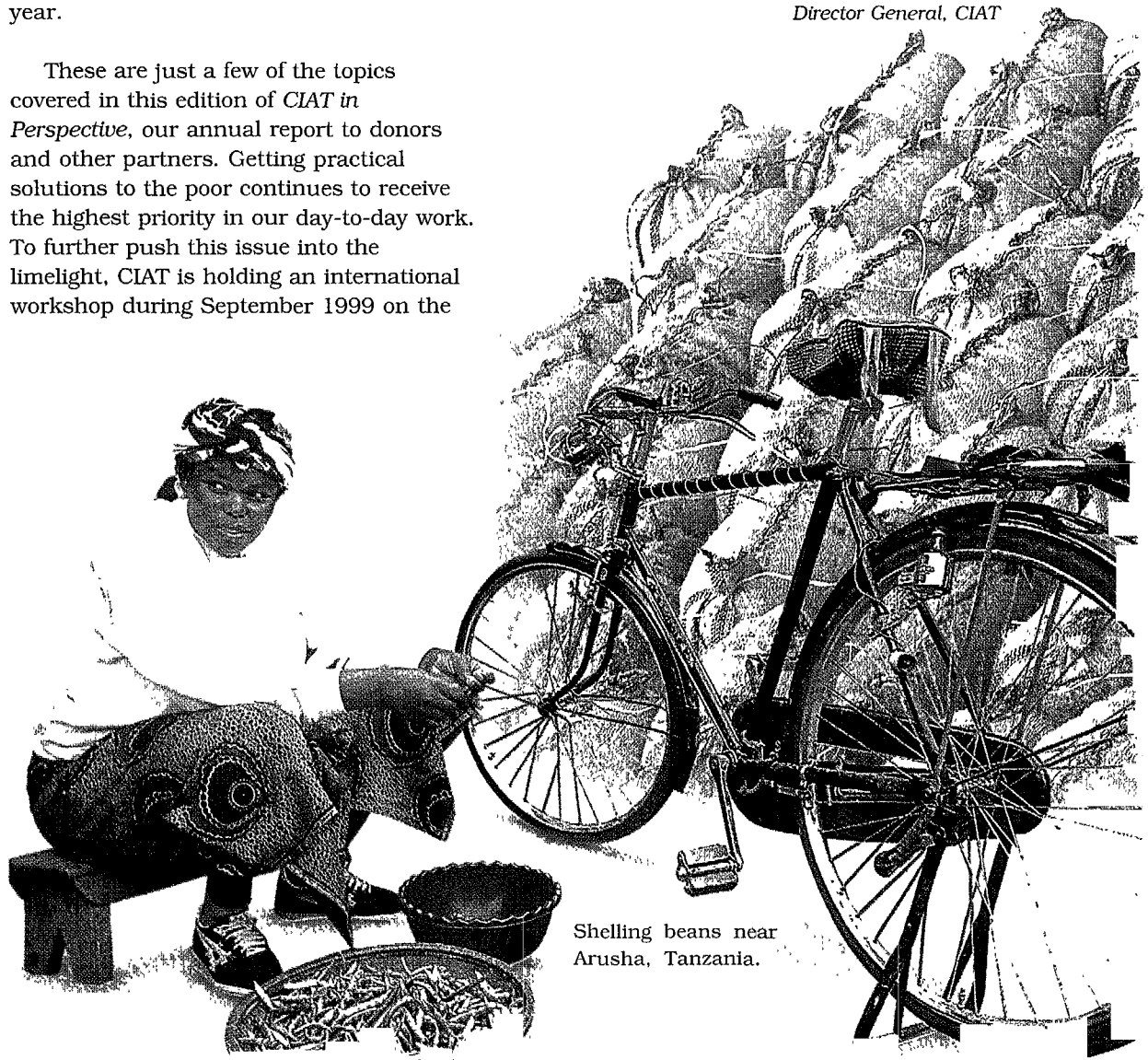
Trade liberalization also offers new opportunities for small farmers to diversify income sources. Alternative crops for emerging export markets can be grown under the labor-intensive conditions of small farms. And small agroenterprises can boost the value of both new and traditional crops, creating jobs and a positive economic ripple effect in the wider community. These are two promising areas in which CIAT is working.

Any serious attempt to help poor farmers requires detailed knowledge of who and where they are, and what their specific needs are—especially as they see them. CIAT has made major investments in geographic information systems (GIS) and participatory research approaches to focus our efforts more sharply on the neediest and to better enable them to build sustainable livelihoods. The urgency, relevance, and utility of this work in Central America has been made all the more clear by the devastation of Hurricane Mitch late last year.

These are just a few of the topics covered in this edition of *CIAT in Perspective*, our annual report to donors and other partners. Getting practical solutions to the poor continues to receive the highest priority in our day-to-day work. To further push this issue into the limelight, CIAT is holding an international workshop during September 1999 on the impact of agricultural research on poverty alleviation. I believe this convocation of nearly 200 experts will help vitalize the global effort to find sustainable pathways out of rural poverty.



Crossing cultivated rice with *Oryza barthii*, a wild relative of the crop, to improve grain yield.



Shelling beans near Arusha, Tanzania.

Grant M. Scobie
Director General, CIAT

Nicaraguan farmer Longino Hernández.

The Complex Web of Deprivation

Longinio Hernández was tending a plot of tomatoes high on a hillside in northern Nicaragua one day last February. That is not the crop he usually grows. But in late 1998, Hurricane Mitch wiped out half his maize and nearly all his beans. "I have high hopes of getting started again," he said. "Even though my beans got waterlogged, the soil wasn't too badly damaged." In the meantime, the fledgling tomato crop, an emergency measure for hurricane victims, is destined for sale. It offers the promise of a little hard cash to buy desperately needed food.

The plight of small farmers like Hernández underlines the vulnerability of the poor in developing countries, especially when disaster strikes. Their room for economic maneuver is slight, even at the best of times. Disaster may arrive in the form of a hurricane, civil war, drought, or a new crop pest. As in Nicaragua, where deforestation turns hillsides into mud slides waiting to happen, the plight of the poor is amplified by environmental degradation.

"A rising tide of wealth is supposed t lift all boats, but som are more seaworthy than others. The yachts and ocean liners are rising in response to new opportunities, but many rafts and rowboats are taking o water—and some ar sinking."

1997 Human Developme Report Overview, United Nations Development Programm (UNDP)

Human versus income poverty

Nicaragua is one of the poorest countries of Latin America, according to the 1997 human poverty index of the United Nations Development Programme (UNDP). By this yardstick about 26 percent of Nicaraguans are left out of national progress.

Of 15 Latin American countries listed, Nicaragua ranks 13th, marginally better off than El Salvador and Guatemala. Among the 77 developing countries covered by the index, Nicaragua holds middle ground, ranking 32nd—just after Vietnam and just before Botswana. If it is logical to speak about an "average" poor nation of the world, Nicaragua seems to fit the bill.

Experts increasingly view poverty as a complex web of interrelated deprivations, not just lack of money or material goods. It is seen less as a state of existence or subsistence and more the result of dynamic impoverishment, driven by social, political, and economic forces. UNDP describes poverty as a "denial of choices and opportunities for living a tolerable life."

The human poverty index, or HPI, does not measure income or lack of it, which for decades has been a widely used weathervane of national development and its dark companion, poverty. Rather, it looks at three other factors that try to approximate the intricacies of human deprivation.

The first is shortness of life. For the developing countries, this indicator records that part of the population that will not live to 40—the current age of the industrial world's youngest baby boomers. The second is lack of basic education, measured by the illiteracy rate. Third is lack of access to public and private resources, as a proportion of citizens without proper nutrition and safe water, and cut off from health services. So the index distinguishes between "human poverty" and "income poverty," the purely economic indicator.

The *1997 Human Development Report*, which introduced the HPI, notes that more than one-quarter of the population of the developing world is poor by this standard. Globally, women are poorer than men, often disempowered, and burdened by the strains of hard work, both in and outside the household.

In Latin America and the Caribbean, human poverty is less pervasive than income poverty. With an overall HPI of 15 percent, it is one region that has

A rural household in central Nicaragua. More than a quarter of the country's population lives in absolute poverty.

managed to reduce some of the noneconomic aspects of poverty. Yet incomes lag and, by this measure, poverty still grips 24 percent of the population, about 110 million people.

Economic growth is a powerful tool for reducing poverty. But its benefits are far from automatic. For example, Honduras, which had annual growth of 2 percent a year from 1986 to 1989, nevertheless saw its level of income poverty double. Now, with thousands killed by Hurricane Mitch and an estimated US$4 billion in damage, the country is rebuilding, almost from scratch. Its predicament gives poverty a whole new meaning.

Feeding body and mind

The nutrition component of the HPI directly reflects the importance of agricultural innovation in fighting poverty. Three-quarters of the world's poorest people live in rural areas and depend on farming and related work to survive.

In most of Latin America and the Caribbean, the number of absolute rural poor, those earning 50 cents a day or less, equals or exceeds the number in cities and towns. Mexico is a striking example: the poorest of the rural poor outnumber the poorest of the urban poor by eight to one.

The rural, agrarian venue of poverty, especially in Latin America, underlines the relevance of CIAT's work, says Douglas Pachico, director of strategic planning and impact assessment. "Not having enough to eat is about as bad as it gets. We're attacking one of the most fundamental aspects of poverty."

Through the eyes of the poor

The UNDP's human poverty index is a vast improvement over conventional assessments that depend on externally defined indicators, such as income. Even so, as rural sociologist Helle Ravnborg maintains, it still has shortcomings; specifically, "there is a need to listen to what local and especially poor people themselves have to say about poverty."

Listening to what the poor themselves have to say about poverty.

One technique that she and others have used to obtain insights into local perceptions of poverty is the well-being ranking technique. Because of the location-specific nature of people's perceptions, however, along with other methodological obstacles, the insights gained in this way have offered *additions* to conventional poverty measures rather than providing a *basis* for poverty assessment.

Through work in Tanzania and Colombia, and most recently in Honduras and Nicaragua, she and her colleagues are developing a methodology that overcomes the shortcomings of participatory poverty assessment. The work in Honduras was conducted with funding from the Inter-American Development Bank (IDB) and Danish International Development Assistance (Danida).

The new approach, presented in a manual published recently by CIAT, provides a comprehensive measure that reflects the multidimensional and dynamic nature of poverty in areas where small-scale agriculture predominates. The method begins by drawing on the perceptions of local informants, who rank their neighbors according to levels of well-being at selected sites. The resulting descriptions are then translated into well-being indicators by means of a household questionnaire administered to a representative sample of households in the study area. Next, the indicators are combined into a well-being index, which can be used to develop a poverty profile for entire study areas.

Planners of development projects in rural areas can thus form an accurate picture of poverty through the eyes of the poor themselves.

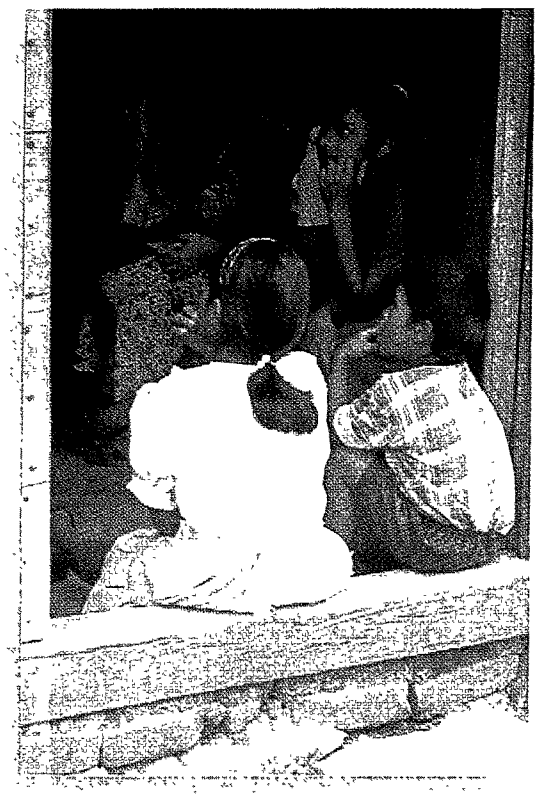
Malnutrition, he says, is among the nastiest of poor people's enemies. "It leads to serious health problems, cripples the cognitive development of children, and erodes human capital." The problem is particularly serious in sub-Saharan Africa and South Asia, where more than 70 percent of the world's underfed children live. The International Food Policy Research Institute (IFPRI), looking at global food security prospects to the year 2020, predicts these regions will remain "hot spots."

Although research helps farmers produce more and better food for home consumption, it needs to do more than that. "People are being left behind even as national economies advance," says Pachico. "It's crucial to link poor farmers to markets."

Adding value to crops via small agroenterprises that respond to clear market demand is one way families can boost income and income security. Although food prices are increasingly determined by global economic forces, not local ones, "agricultural technology is still the best way to keep communities competitive in the global market," says Pachico.

At the same time, research should help poor communities create fertile ground for "accumulating assets." Of particular importance are nonmaterial ones like knowledge of the biophysical environment, resource management skills, market savvy, organizational capacity, and the ability to communicate needs and ideas. "Research itself can't take people out of poverty," says Pachico. "But it can and does open opportunities for them." His views echo those of UNDP experts: "A people-centered strategy for eradicating poverty should start by building the assets of the poor—and empowering the poor to win their fight against poverty."

The Nicaraguan hillside community where Longinio Hernández was growing his tomato cash crop is the site of a project in which CIAT and its national partners aim



to do just that. It centers on empowering a poor farm community of some 24,000 people to take charge of managing the natural resources of their watershed.

Optimism and the way ahead

We have stressed here the great extent of rural poverty, especially in Latin America. Yet, there are many reasons for optimism when you look at the big picture.

In the past 50 years, poverty reduction has been greater than in the previous 500. Child death rates in the developing world are about half what they were in 1960, and the proportion of rural households with no access to safe water has dropped from about 90 percent to 25 percent. Great strides have been made in reducing the proportion of people living below national income-poverty lines. Overall, people live longer and access to basic social services has improved.

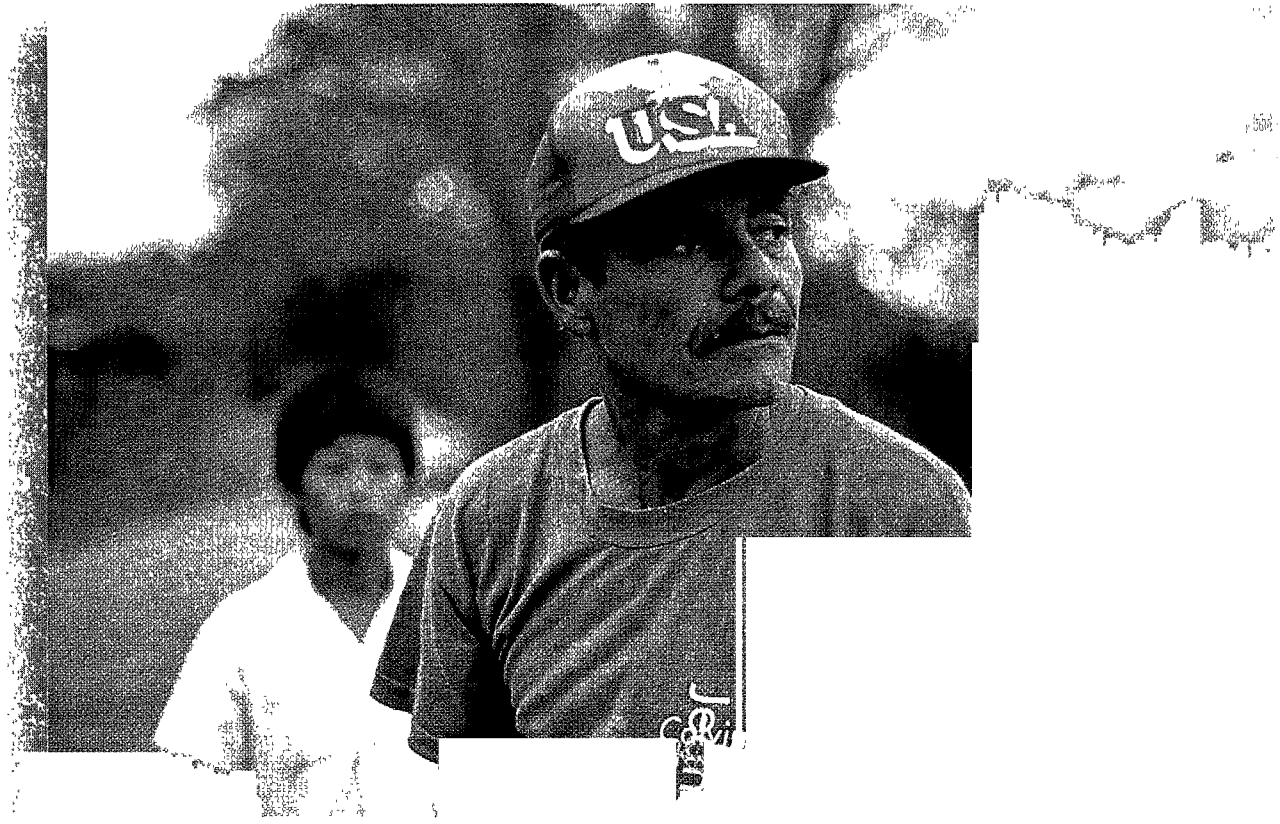
These and other advances, says UNDP, show that eradicating severe poverty over the coming decade or two is feasible, "well within our grasp." Projections from the Food and Agriculture Organization (FAO) also point to future progress. Despite population growth, it expects the number of food-insecure people in the world to drop from 840 million, the figure for 1990-92, to 680 million people in 2010.

According to IFPRI prospects for economic growth over the next 25 years are also favorable. In fact, rates in the developing countries, the locus of poverty, are expected to be almost double those for industrial countries.

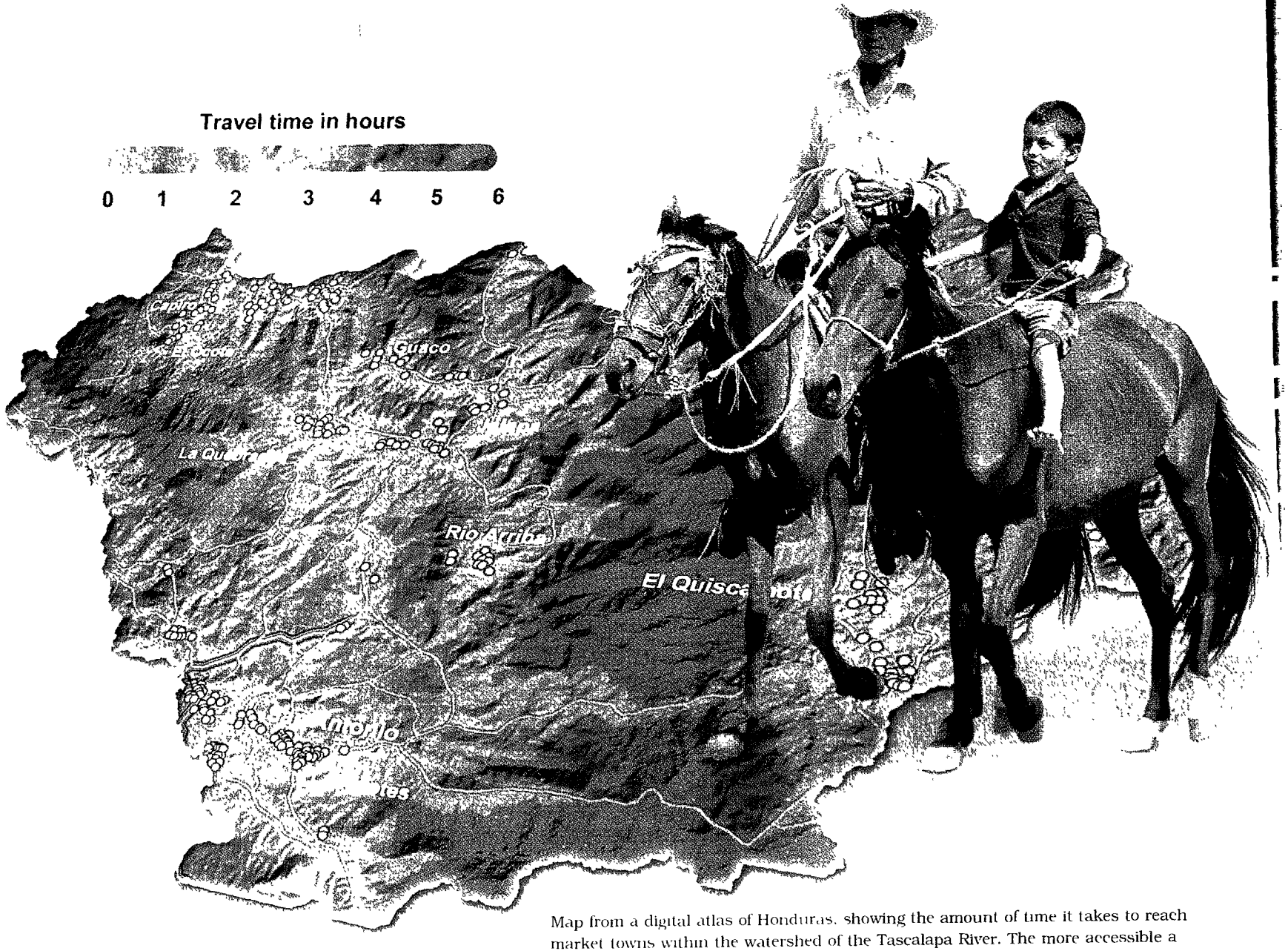
But while "a rising tide of wealth is supposed to lift all boats," many will founder unless strong measures are taken now and in the future. The incentive to act should be the simple fact that the absolute number of poor in the world today remains staggeringly high. Each poor household remains a collective moral debt unpaid.

Among suggested priorities for action, UNDP cites the creation of an enabling environment for small-scale agriculture and microenterprises. It also calls for a second Green Revolution for poor farmers bypassed by the first and the reversal of environmental decline in marginal, fragile areas.

Different players will define and pursue these goals differently. As illustrated in the rest of this report, CIAT remains committed to doing its part.



The harsh realities of rural life in Latin America and other regions of the developing world underscore the need for people-centered solutions that empower poor farm communities.



Map from a digital atlas of Honduras, showing the amount of time it takes to reach market towns within the watershed of the Tascalapa River. The more accessible a location is, the better its opportunities for development but the greater the danger of increased pressure on natural resources.

Pinpointing Poverty

Just a few decades ago, the first space-based photos of the Earth indelibly altered humanity's collective sense of "home." Today, geographic information systems (GIS), cousins to some of the original technologies involved in bringing us those historic images, are sharpening our understanding of life and helping solve urgent problems in that sometimes troubled home. Computer-based GIS technologies allow us to map not only the biophysical face of our planet—crops, climate, soil, water, forests, and so on—but also its social dimensions, particularly how human welfare is welded to the landscape.

By using GIS to harness such information, researchers, planners, and community groups can make better decisions about allocating resources and design better projects for helping needy rural communities and small-farm families. In this section we look at projects in Peru and Honduras that illustrate how GIS is helping to map poverty and identify its links with agriculture and other land uses.

"It is the livelihood of the poor and their hopes that shrivel in the arid anguish of drought and are drowned in the raging fury of the floods."

Klaus Toepfer,
Executive Director,
United Nations
Environment Programme
(UNEP)

Peru's value-added census

In eastern Peru's Ucayali region, near the town of Pucallpa, migrant farmers and entrepreneurs are pushing, year by year, into the wild tropical frontier of the Amazon Basin. Deforestation is eating away at this treasure of biodiversity and other natural resources.

Part of the region serves as a "benchmark" site for research, an area in many ways typical of the forest margins agroecology elsewhere in Latin America. The area around Pucallpa is a giant living laboratory where CIAT, other international centers, and national partners can learn how to improve land use at the intersection between people and trees.

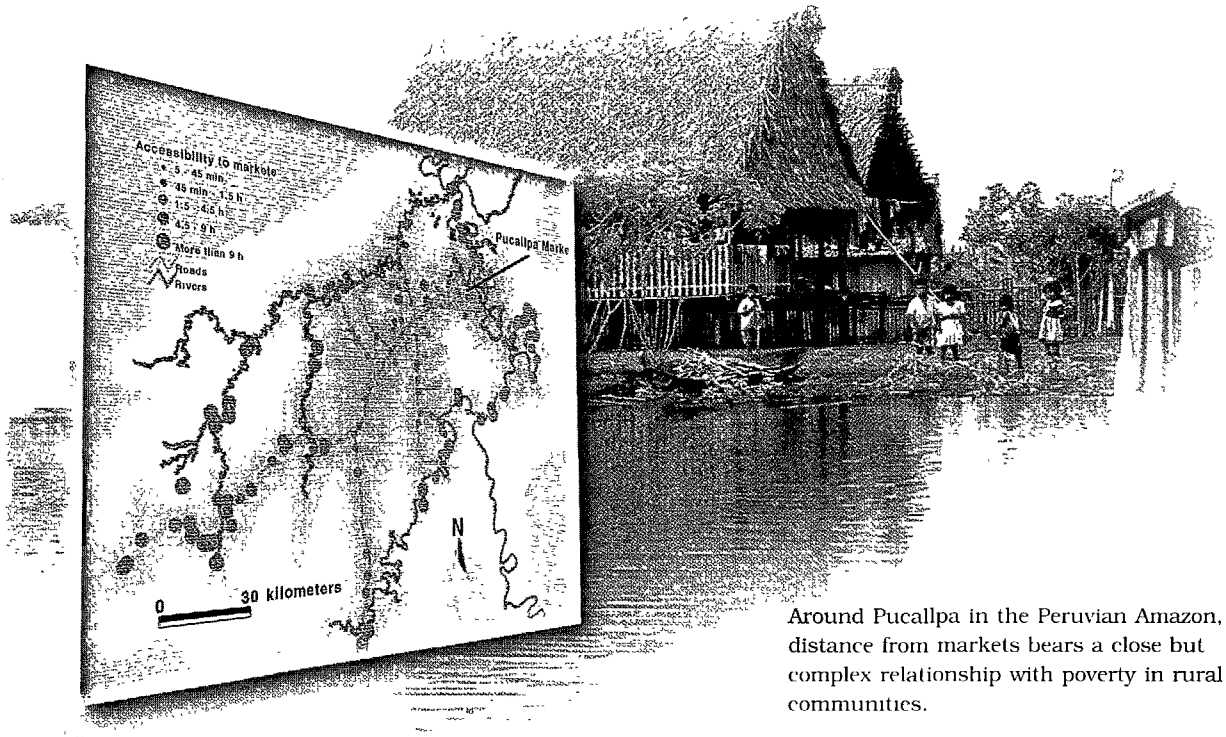
Despite the wealth of nature here, human deprivation is the norm, not the exception. An estimated two-thirds of rural households live and work in absolute poverty. What are the causes, and which factors most influence people's access to resources? Policy? Ethnic differences? Illiteracy? The land tenure system? Access to technology? How can people's farming systems—their livelihood—be used as points of intervention to alleviate poverty, while protecting the threatened environment? These are key questions that CIAT researchers, in a joint project with Peru's National Statistics and Census Institute (INEI), are out to answer.

In 1994, INEI conducted an agricultural and population census of Peru, based on household surveys. The resulting mountain of tabular information is essential to national planning in all sectors. But it would be a more useful input to research, policy, and development if the data sets could be easily and quickly compared, with each other and with other information about the Peruvian landscape.

Toward this end, GIS specialists at CIAT captured a subset of tabular data from the census in a geographic information system covering 5,000 households in four districts near Pucallpa. "We want to help statistical agencies like INEI make their data more accessible to people working in agriculture and natural resource management," says CIAT geographer Glenn Hyman.

From the original census work, the Peruvians formulated five poverty indicators. These reflect "unmet basic needs," as recorded in the quality of house construction, people per room, method of human waste disposal, children's attendance at school, and dependents per breadwinner in the household. The indicators were applied at the district level. CIAT staff then helped repeat the analysis at a lower level—the village—to give a more detailed picture of poverty in the target site.

With agricultural and social data now linked in a relational database, the two sets can be easily combined and viewed on GIS maps. This allows researchers to test hypotheses and answer questions about how resource use and agriculture affect poverty.



Around Pucallpa in the Peruvian Amazon, distance from markets bears a close but complex relationship with poverty in rural communities.

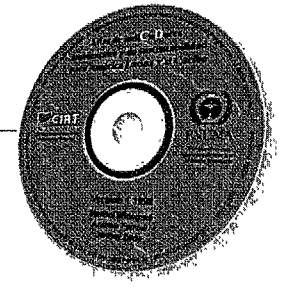
For example, do communities that keep livestock fare better than those that do not? The project team plotted the number of cattle per person against the proportion of village households for whom all five basic needs were unmet. The comparison showed them that, when livestock are part of the farming system, village poverty does tend to be lower. Similarly, it is now possible to investigate whether human welfare levels are better in communities where nontraditional crops, like pineapple and camu-camu (a forest fruit), are produced for export.

Another hypothesis being put under the microscope is that of the "poverty trap," a sort of downward spiral in which poverty and environmental degradation feed one another. In Ucayali, this process centers on slash-and-burn farming. Over a few years, farmers plant rice and maize on cleared forest plots, followed by cassava. When the soil becomes exhausted from cropping and weed growth is prolific, they have to move on to clear another site.

The question is whether environmental degradation is really at the root of poverty and vice versa. What other important forces are at work? Hyman notes that there is evidence of extreme poverty even where soil fertility remains high, as on river flood plains. And other factors, he says, like poor road access to agricultural markets, may turn out to be even more serious obstacles to human welfare in this area.

Many farmers in the Ucayali region use small motorized river boats called "pecky-peckys" to get around. Nevertheless, transport, especially by road in the rainy season, is at a premium and often unreliable. "A lot of these people are isolated," says Hyman. "On a particular day, they may or may not get their plantains to market. Accessibility, I believe, is a big factor in poverty."

The GIS and database development work now provide a platform for testing such ideas about the causes and effects of poverty in the benchmark site and for proposing solutions.



GIS basics

The information needed by planners, policy makers, and others involved in development normally comes from multiple sources. Formats are often incompatible, or the data are at different time and space scales, making comparison and analysis difficult. Geographic information systems help resolve such difficulties.

Simply put, a GIS is a computer-based framework that allows different kinds of information to be geographically tagged ("georeferenced"), integrated, and displayed together on a single map. Users can combine two or more distinct data sets to view relationships between selected social or biophysical factors.

For example, government planners might want to see how rural population growth could affect protected forests in their country. A GIS like the *Atlas of Environmental and Sustainability Indicators for Latin America and the Caribbean*, which CIAT and the United Nations Environment Programme (UNEP) published on CD-ROM in late 1998, allows them to overlay the necessary parameters on a basic geographical map. These might include current boundaries of forest reserves, the road system, and projected population patterns. The resulting composite map can reveal potential hot spots—areas vulnerable to human encroachment, especially farming. The planners could then design land- and water-use projects and policies for that area with those cautions in mind.

So, a GIS does not consist only of static maps. It is a dynamic tool that lets users rapidly make and remake maps, with different mixes of information depending on what is being analyzed. Some of these tools allow users not only to visualize the current "real" state of the landscape, but also simulate alternative future states, based on different policy scenarios or projections.

Sharpening poverty analysis in Honduras

In Honduras CIAT and its national partners are quite advanced in combining GIS, database management, and social science methods for the purpose of better targeting efforts to reduce poverty. In a project funded by the Inter-American Development Bank (IDB), the Center's GIS team is profiling poverty in Honduras and its links with environmental decline.

The work began with a fresh look at data from a national census of Honduras conducted a decade earlier—a survey of 4.2 million people in nearly 900,000 households. From the analysis of household data, researchers designed poverty indicators based on "unmet basic needs," the same method used in Peru and other countries. Households, villages, and municipalities were classified into five categories, ranging from extremely poor to "above the poverty threshold." Researchers integrated the results with a CIAT-developed digital atlas of Honduras showing 3,730 village sites and other biophysical features.

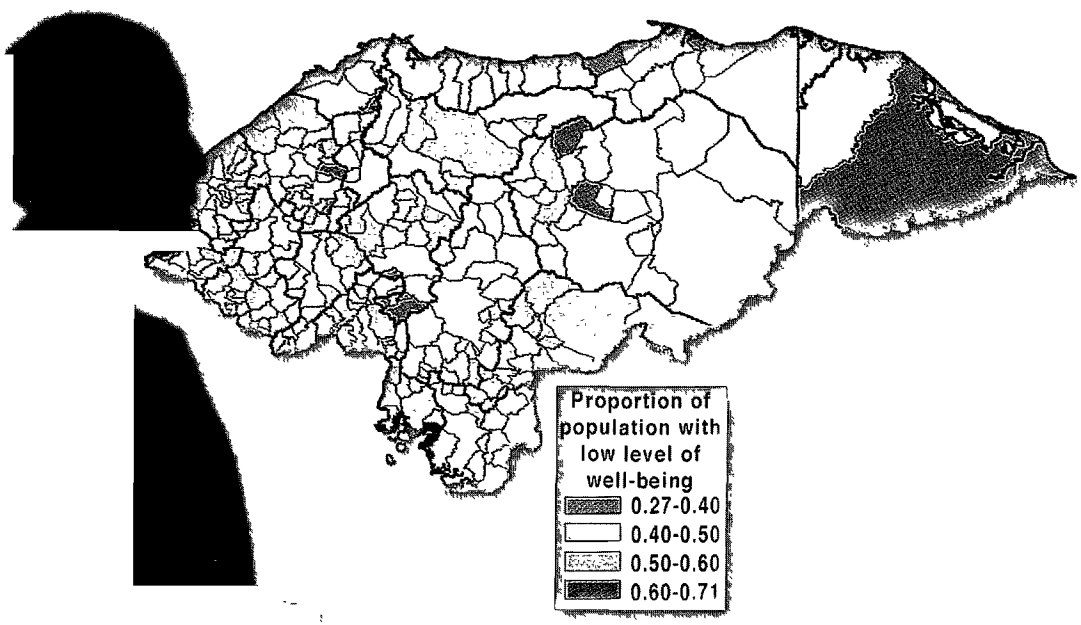
The study results showed a national poverty level of about 55 percent. When lack of education was factored in, the rate jumped to 59 percent. Of Honduras's 18 departments, Intibuca and Lempira had the highest incidence of poverty, embracing 80 percent of the population. Overall, the results were a close match with those of other studies of poverty in Honduras.

Even so, these results do not constitute a universal and absolute assessment of poverty in the country. Using the census data, it is possible to develop more "customized" poverty indicators, emphasizing the particular dimensions of deprivation (access to education or health services, for example) that a given project or organization wants to address. The project has also demonstrated that the census information can be usefully complemented by poverty indicators developed through participatory methods (described in the preceding chapter) to take into account the perceptions of poor people themselves. Toward this end a study of a large number of contrasting rural communities identified 11 factors that can be incorporated into a poverty index for Honduras. These local poverty indicators have been linked to the census data to produce national-scale poverty maps.

The research has provided Honduran policy makers and the development community with more than poverty statistics and recommendations. It equips them with a sharper, more flexible "decision support tool" for poverty analysis than the census information by itself could provide. In addition, the visual interface—maps that can be viewed on screen or printed—makes analysis much more user friendly.

Products of the research also allow users to see whether, how, and where poverty levels are related to environmental degradation. The link has been assumed by many but requires complex analysis to document, and the analysis needs to be done by people with a thorough knowledge of the country. Even so, as CIAT's Grégoire Leclerc, a GIS specialist who worked on the project, puts it: "This work will help separate myth from reality." Even local

A profile of poverty at the municipal level in Honduras, based on poverty indicators developed with participatory methods.



groups lacking computer technology can improve their understanding of human welfare patterns by obtaining hard copies of the relevant maps. Again, Leclerc: "Such tools have enormous potential for empowering local communities in the fight against poverty."

A school destroyed by Hurricane Mitch in Yoro Department, Honduras.

A commitment to global information sharing

Like the rivers, forests, and mountains they chart, geographic information systems reach beyond national boundaries. It is not surprising, then, that GIS specialists tend to believe strongly in the importance of sharing information globally. To this end CIAT has been both an enthusiastic promoter of, and participant in, the new Consortium for Spatial Information (CSI), sponsored by the Consultative Group on International Agricultural Research (CGIAR).

The initiative, involving nine international research centers, had its first major planning meeting in Norway in December 1998. The consortium will work on a spectrum of GIS issues, ranging from crop improvement and germplasm analysis, to land degradation and human welfare.

In 1998, CIAT's GIS laboratory also became a node of the Inter-American Geospatial Data Network (IGDN), a joint effort of the US Geological Survey, the UN Environment Programme, and the Pan-American Institute of Geography and History. As IGDN is a key channel for sharing geographic information in the Western Hemisphere, it is an honor and major responsibility for CIAT to take on this role. It has already strengthened our GIS work and led us to implement international standards for mapping and imagery precision.

The Mitch Atlas

GIS work in Peru, Honduras, Nicaragua, and elsewhere is part of a long-term effort to ground decisions about agriculture and natural resource management in good science. But last November, CIAT's GIS capacity also proved a godsend in the emergency response to Hurricane Mitch, the worst natural disaster to strike Central America in this century.

Honduras and Nicaragua were hardest hit, with Honduras taking the brunt. Much of the damage was caused not by high winds but by 2 meters of rain that fell in just a week. Flooding and mudslides killed thousands of people and wiped out both commercial plantations and small farmers' bean and maize crops. An estimated 60 percent of the combined agricultural land of the two nations was severely damaged. Bridges and roads were washed away, complicating relief efforts.

One of the fruits of CIAT's extensive GIS work with Honduras in recent years is a digital atlas of the country, available on CD-ROM. Developed over 4 years with support from the Swiss Agency for Development and Cooperation (SDC) and the Netherlands' Ecoregional Fund to Support Methodological Initiatives, it is perhaps the most comprehensive biophysical and socioeconomic database on Honduras ever compiled. Its formal release, accompanied by a training workshop, was in October 1998, just 3 weeks before Mitch struck.

CIAT thus found itself in an opportune position to help gather and integrate information that could be used to guide emergency measures. Because of the training workshop, word of the electronic atlas spread quickly. "We were bombarded with requests for maps and other information to help people plan relief efforts," says CIAT's Leclerc. The global medical relief agency Médecins Sans Frontières, for example, was one of many groups that contacted us.

On the Friday after the hurricane, the Canadian Space Agency reprogrammed a radar satellite, which can "see" at night and penetrate clouds to obtain images of the devastation. These were quickly processed by a firm in Canada, using ground reference data provided by CIAT.

Leclerc and his team loaded the satellite data into the Honduras atlas to permit better damage assessment. The researchers also beefed up the GIS database with other information, such as the geographical distribution of key crops, the location of key public and private institutions, and the sites of major drinking water sources. "Within a week, we had a reasonable set of emergency maps for users to work with," says Leclerc.

By January CIAT scientists had released a "Mitch Atlas" of Honduras on CD-ROM. Two thousand copies were produced with the collaboration of the US Geological Survey (USGS) and the Environmental Systems Research Institute

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SCIENCE AND TECHNOLOGY

A deluge of information

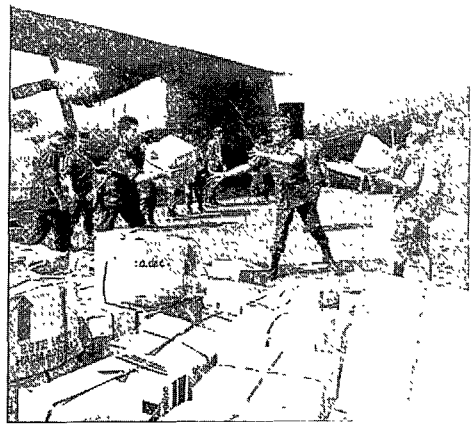
CALI COLOMBIA

ON THE face of it, computers would not seem to be of much use when it comes to disaster relief—certainly not when compared with such things as helicopters, emergency supplies or medical equipment. But when it comes to clearing up the mess, having vital information on tap can play a vital supporting role—as the current disaster in Honduras shows.

In October, a few days before the arrival of Hurricane Mitch, the finishing touches were put to a digital atlas of the country. Compiled by the International Centre for Tropical Agriculture (CIAT) in Cali, Colombia, it contains 90 layers of information gathered over four years, including details of soil type, crop distribution, climate, population and topography, along with every town, village, road, bridge, marketplace and water pump in Honduras. Originally, the idea was to use this information for agricultural and environmental planning. Instead, it may

ture. In order to generate the "after" picture, another layer of data was needed, showing the depth of the water.

This information has been provided by Radarsat, a Canadian satellite capable of detecting detailed water and land features through thick clouds, fog and rain using synthetic-aperture radar equipment. With this technology, the motion of the satellite is used to simulate the large antenna needed to take high-resolution images. Suitably massaged, the satellite data allowed an extra layer to be added to the digital atlas, showing the extent of the flooding. In addition, the database is being updated continuously to show which roads and bridges are impassable. The result has been dubbed the "real-time Mitch atlas".



Pass the database

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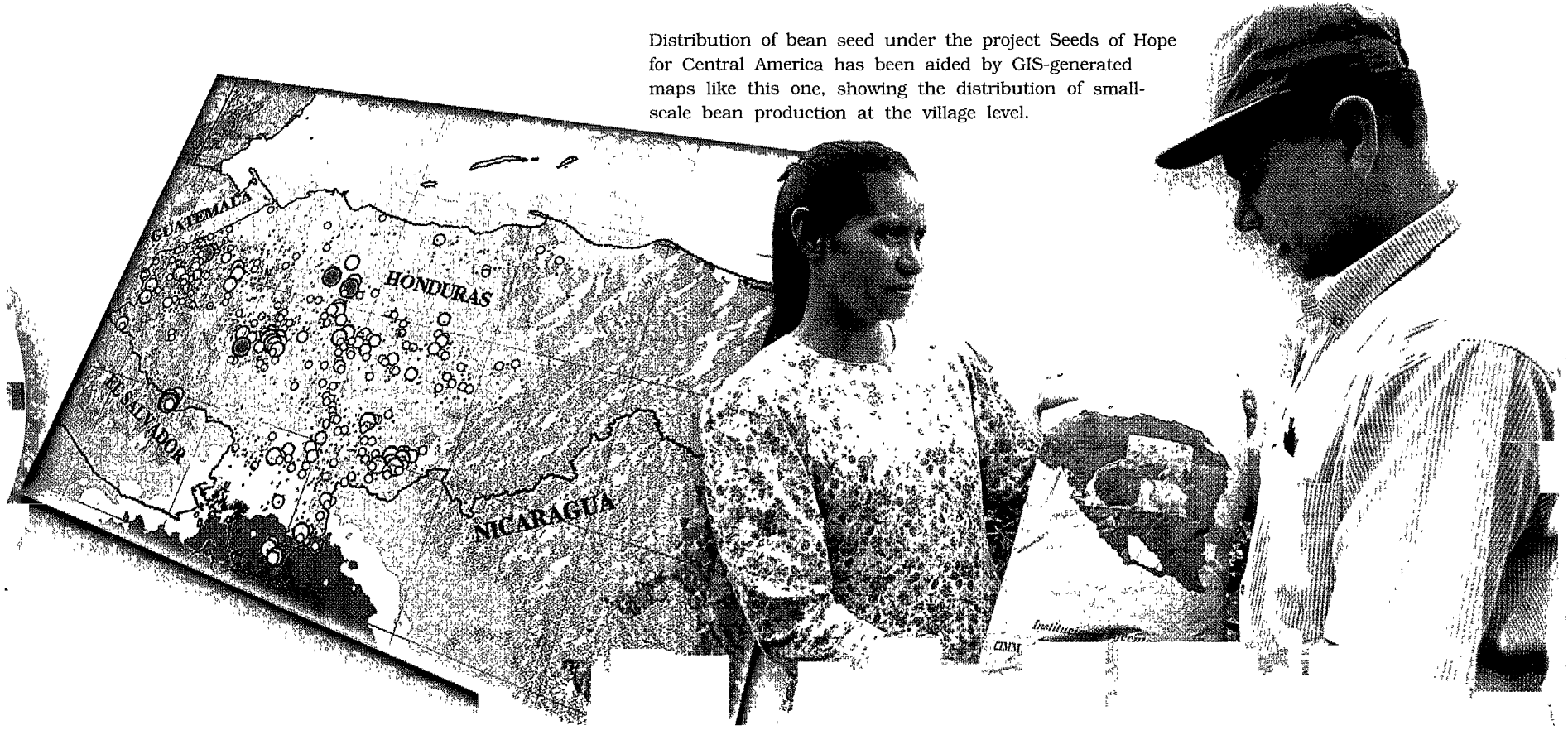
(ESRI). Center staff also contributed to the development of a complementary tool, the *Digital Atlas of Central America: Prepared in Response to Hurricane Mitch*, which was copublished by the USGS, ESRI, and CIAT.

The story does not end there, however. While the flood waters have receded, their imprint on the land could last for decades. Restoring the layer of arable land that was washed away on many hillsides will take years. But the more immediate and daunting task for millions of rural Hondurans and other hurricane victims in Central America is to plant crops and rebuild their farms.

In support of national efforts to regenerate food agriculture in Honduras and Nicaragua, CIAT and three other CGIAR centers have launched a project called "Seeds of Hope for Central America." Initial funding comes from the Office of Foreign Disaster Assistance of the US Agency for International Development (USAID) and the Multilateral Programs Branch of the Canadian International Development Agency (CIDA). The project's immediate task is to multiply seed of appropriate crop varieties and distribute it through networks of researchers, development workers, and farmers.

With the aid of the Mitch Atlas, seed distribution is being targeted to the farming communities most in need. One agency that is using the atlas for this purpose is the Central American Red Cross. According to Andrew Pinney, coordinator of the Red Cross program for agricultural regeneration, "We took advantage of the atlas to determine exactly where to distribute a particular bean variety . . . . I had a lot of specific questions, and the atlas provided answers."



Distribution of bean seed under the project Seeds of Hope for Central America has been aided by GIS-generated maps like this one, showing the distribution of small-scale bean production at the village level.

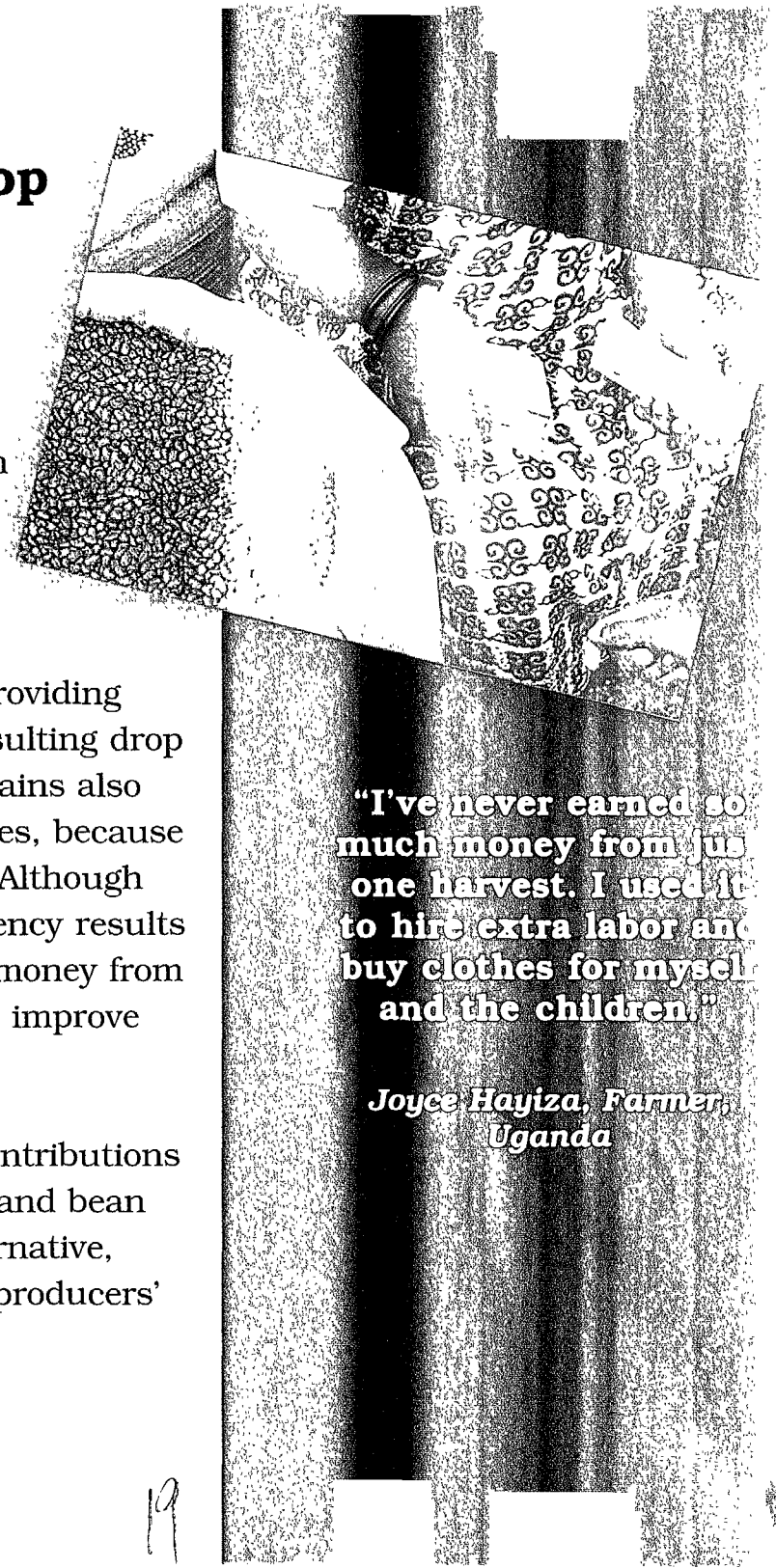
Fertilizer application in rice at Saldaña, Tolima Department, Colombia.

The Dollars and Sense of Crop Improvement

The pure subsistence farmer—cut off from the market economy, eating only what can be coaxed from a small plot of land—is a myth. Poor producers, like richer ones, are nearly always both buyers and growers of food.

Thus, when science boosts crop productivity by providing improved varieties, all consumers benefit from the resulting drop in price—poor farmers included. But productivity gains also mean more income for farmers who adopt new varieties, because they can grow more with the same land and labor. Although inputs such as fertilizer may be needed, greater efficiency results in more surplus to sell, or at least more time to earn money from other sources. Either way, farmers gain leverage to improve family incomes.

In the next few pages, we examine recent and past contributions of CIAT and its national partners to improving rice and bean production. We also look at how research on alternative, nonstaple crops is helping put extra money in poor producers' pockets.



"I've never earned so much money from just one harvest. I used it to hire extra labor and buy clothes for myself and the children."

Joyce Hayiza, Farmer, Uganda

A taste for rice

Over the past 50 years, consumption of white rice per person has tripled from 10 to 30 kilograms in Latin America and the Caribbean. Today, the crop is the top food grain in the region's tropical areas.

On the consumer side, the increase has been largely driven by rapid urbanization. Seven of every ten people in the region now live in towns and cities. Convenience foods are but one small luxury sought by rich and poor alike, as lifestyles and job patterns change. Rice is easy to carry home, store, and cook. It is an attractive alternative to bulky, highly perishable staples like cassava and plantain.

On the supply side, flows of improved rice varieties to producers launched a productivity revolution. Average yields in flooded rice fields—irrigated or naturally wet areas—rose from 3.3 tons per hectare in the mid-1960s to 4.6 tons in 1995. Overall production has doubled, and today the region is just about self-sufficient in rice. By 1995 modern semidwarf varieties accounted for 80 percent of the region's total production (by weight). In flooded systems, which produce 81 percent of total output, their penetration reached 93 percent. For rainfed upland rice systems, the figure is 26 percent.

What has been the role of crop science in this success? A 1998 impact study conducted by CIAT and the International Food Policy Research Institute (IFPRI) estimates that over three decades the region's national agricultural research programs have released nearly 300 new rice varieties, most for irrigated areas. Nearly 40 percent of releases were based on crosses made at CIAT. Another 11 percent came from crosses by the International Rice Research Institute (IRRI).

The biggest winners in this rice boom have been consumers. "More efficient production of the crop on such a large scale has brought down its price by about 50 percent in real terms over the last three decades," says Douglas Pachico, CIAT's director of impact assessment and an author of the study. "Consumers have enjoyed savings of US$518 million per year since 1966."

Low prices are especially helpful to the poor, who spend half their income on food, with rice accounting for 15 percent of total food purchases. "For the 20 percent of tropical America's population with the lowest incomes, rice is the number one staple for both calories and protein," says Luis Sanint, executive director of the Fund for Latin American Irrigated Rice (FLAR), a self-financed, mainly private-sector consortium composed of 13 national organizations and three international centers. "That's why it's so important to have low prices."

Producers in irrigated rice areas have also captured large benefits, totaling $437 million annually. These gains have been offset somewhat by losses in nonirrigated systems, mainly in the upland rainfed areas of Brazil. But, while some poor upland farmers may "lose as producers, they win as rice consumers," says Sanint.

CIAT's strategy of working with national programs to get better rice germplasm to farmers has clearly paid off. Now the

Loading harvested rice at Saldaña, Tolima, Colombia.

national programs do most of their own breeding, often using CIAT materials as parents. And with the creation in 1995 of FLAR, private firms too are taking more responsibility for funding variety development.

Maturing institutional arrangements are just one reason why CIAT has focused more in recent years on strategic issues that will affect future rice production. A major one is the genetic base of Latin America's rice industry. Breeders have already squeezed most of the valuable yield-related genes out of the available germplasm pool. But unless yields continue rising, production will not keep pace with demand, and rice prices will go up. A narrow gene base will also make the crop more vulnerable to diseases and other stresses, further compromising productivity.

CIAT is pursuing a vigorous, multipronged strategy to widen the genetic variability of rice. Crossing commercial rice varieties with wild relatives of the crop is among the most promising lines of attack, says Fernando Correa, the Center's rice project leader. On the disease front, Center scientists are using transgenic biotechnology to fight an important enemy of rice specific to Latin America—the "rice hoja blanca virus" (RHBV), transmitted by leafhoppers. Genetically modified rice plants, bearing a protective foreign gene, have been produced at CIAT and crossed with commercial varieties. Results have been encouraging, and further evaluations are in progress under rigorously controlled conditions.

In the meantime, Center scientists continue to work closely with FLAR and national programs to promote a productive and competitive rice industry in Latin America and the Caribbean.

Counting on beans

"We're selling Q'osqo Poroto, toasted and packaged, to tourists traveling on the train," says Peruvian farmer Rosalía Medrano. "The extra money helps us support our families." The snack food on offer is like popcorn. But it is made from a recently improved variety of popping bean, a crop cultivated for millennia in this mountainous region of South America.

Medrano belongs to the "Mothers Club," a group that teaches local women different ways to prepare this highly valued grain legume. Once trained, these residents of southern Peru's high Andes—descendants of the Incas and among Latin America's poorest people—pass on their expertise to others. Apart from sales income, protein-rich beans also provide children a more balanced diet, both at breakfast and lunch.

Rice is the preferred food grain of rural and urban consumers alike across tropical America.

Before the new variety was released in 1996, researchers from Peru's National Agricultural Research Institute (INIA) experimented with Q'osqo Poroto for several years, helped by farmers in the Cusco area. The trials, which demonstrated the good disease resistance and high yield of the popping beans, were sponsored by the Regional Bean Project for the Andean Zone (PROFRIZA), a research network funded by the Swiss Agency for Development and Cooperation (SDC).

Peru's experience with the distinctive popping beans is part of a wider trend toward higher bean productivity in Latin America. While the total area planted to common bean has expanded only 2 percent over a decade, overall production increased 25 percent, from 4.2 million tons in the mid-1980s to 5.3 million in the mid-1990s.

Better yields, thanks to breeding research by CIAT and national partners over the past 25 years, have been the engine behind the production boom. Annual yield growth is now 2.7 percent, well above the region's population growth rate. Improved bean varieties are found on small farms throughout Latin America. To date, national research programs have released about 225 new varieties with CIAT support. At least 40 percent of the total bean area is now planted to improved varieties.

Small farmers tend to grow beans in various combinations with other crops. Much of the appeal of new bean varieties, with different plant types and growth periods, lies in their ability to fit easily into complex cropping systems. They also feature multiple disease and insect resistance as well as tolerance to drought and low soil fertility.

Cultivated "common beans," despite the uniformity suggested by the name, are anything but that. They come in many shapes, colors, textures, and tastes. The variation reflects enormous diversity in Latin American consumer preferences, a fact that research must address if farmers are to embrace new varieties.

"If you bring a red bean from country X to El Salvador, people don't want it!" says Oswaldo Voysest, PROFRIZA's coordinator. "Tastes vary. Our clients may be poor, but they are real gourmets." Voysest stresses the strong link between bean research and rural welfare. Beans are the "meat of the poor." Besides their high protein content, they also provide essential micronutrients.

"If you work with beans in a region like the Andes, you're working with poor people." Better beans, he says, creates badly needed jobs because cultivation is so labor intensive. It also allows for surpluses to be marketed locally or even internationally.

To underline his point, Voysest cites a success story from Bolivia's Santa Cruz region where, ironically, people have not traditionally been big bean eaters. Severe poverty and food shortages in the 1980s, linked to a decline in the mining sector, led people to take up farming and

Candied Nuña popping beans for sale at Yanahuara in the Sacred Valley of the Incas, Peru.

eventually supplement their single maize crop with a winter bean crop.

"Bolivia started from zero in 1986 but now plants 15,000 to 20,000 hectares," says Voysest. "Who plants those beans? Small farmers. They've even created their own export agency. They now sell to Brazil, Colombia, and Japan." The farmers' association that runs the agency, along with a local university and government institute that provided research support, are active PROFRIZA members and CIAT partners.

To maintain the momentum of bean successes in Latin America and Africa, there is a growing need for strategic research. César Cardona, CIAT's bean project leader, sees a continuing and critical role for the Center and its partners in improving yields and developing better insect and disease resistance and tolerance to low soil fertility. To speed the progress of this work, CIAT scientists are using various biotechnology techniques to harness valuable genes from wild relatives of beans. The aim, Cardona stresses, is to bring profitable, environmentally friendly solutions to bean growers everywhere.

Winnowing a harvest of improved Nuña beans at Ollantaytambo in the Sacred Valley of the Incas, Peru.

Improved bean seed saved for harvest near Mbale in southeastern Uganda.

Staving off hunger in eastern Africa

Eastern Africa is one of the developing world's key bean-growing regions. In eastern Uganda, many families, after selling part of their bean crop for badly needed cash, start running out of food in February. So women resort to the time-consuming job of gathering wild plants to stave off hunger.

Two improved bean varieties that originated at CIAT were introduced in 1995 by Uganda's National Agricultural Research Organization (NARO) and are helping to reverse the situation. An impact study showed that, during the hungry season in April 1998, three-quarters of households in Nabongo Parish that had grown the new varieties still had beans in storage. Only half of the nonadopters still had supplies.

The higher quality beans also fetched a better price. Several households had enough cash to buy other foods and pay children's school fees. And six ambitious farmers, recognizing a good thing, recently set up a small business to multiply and sell seed.

Crop options for a changing global economy

New trading arrangements and cuts to agricultural subsidies are changing the face of world agriculture. While this opens up new market opportunities, farmers in tropical countries are worried. Many can no longer profitably grow traditional crops, such as wheat, maize, and barley, since these can be produced more cheaply by highly efficient foreign competitors.

Nonstaple commodities, including market-garden vegetables, flowers, oil palm, and tropical fruits, have historically received scant scientific attention from national and international research. Yet, such high-valued alternative commodities that thrive in tropical settings may well be a solution for millions of small farmers struggling to adapt to new economic realities. And by diversifying their production, poor farmers can improve their food and income security.

While continuing research on beans, cassava, rice, and forages, CIAT is also helping national programs and farmer groups find solutions to production problems encountered with other crops. The Center does not intend to embark on breeding of these crops, but there are many ways in which it can support this and other crop research in local institutions

"If we're serious about reducing poverty, we may have to move into other crops," says Aart van Schoonhoven, CIAT's director for research on genetic resources. The center is responding to these emerging needs, he explains, wherever it sees itself with a comparative scientific advantage. Various areas of Center expertise, such as plant pathology, biotechnology, soil management, and genetic resource conservation, can be usefully applied to alternative crops. Such assistance is paid for by the private producer groups who stand to benefit.

Delivery of oil palm seeds for processing on Colombia's humid southwest coast.

The shift to alternative crops, often for export, raises new problems, including environmental threats. Some crops demand a hefty investment from farmers. A plot of tomatoes, for example, may require up to 10 times more resources than a bean plot of equal size, says CIAT virologist Francisco Morales. "Many farmers spray chemicals on their crops every other day right up until harvest," hoping to protect the investment from disease and pests. "If we don't provide technical assistance to those countries and farmers trying to produce nontraditional export crops, then we may unintentionally contribute to environmental deterioration," says Morales.

Recently, Morales and colleagues shared their expertise with oil palm producers in the municipality of Tumaco on Colombia's humid southwest coast. The area, producing some 13 percent of Colombia's African oil palm, is home to some of the country's poorest farmers.

In recent years, two diseases, ringspot and chlorotic ring, have been attacking oil palm plants up to 3 years old in nurseries and commercial plantations. Unfortunately, diseased plants are hard to spot in nurseries, so infected planting stock is commonly introduced into commercial plantations, causing serious losses.

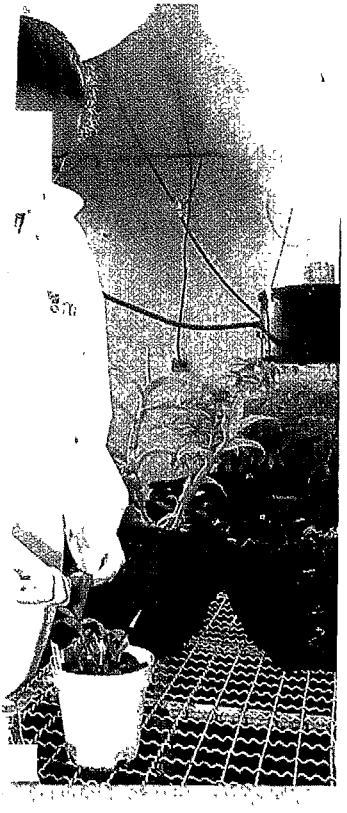
CIAT was contacted by the Center for Research on Oil Palm (CENIPALMA), the research arm of a producer group, to help find a solution. At CIAT's virology laboratory, Morales and his colleagues were able to detect two different viral pathogens associated with the oil palm ringspot and chlorotic

ring diseases. At least one of these diseases has an aerial vector, probably an aphid.

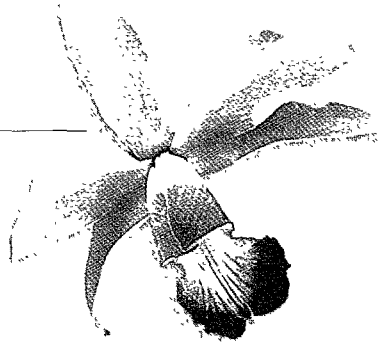
"We now know we're dealing with at least one virus and possibly two viral diseases, and we already have diagnostic methods available," explains Morales. "We need to adapt those techniques for mass use in the nurseries in Tumaco." This will help both small and large producers ensure that young palms being transplanted to fields will not die or become diseased soon after transplanting. The research is particularly timely since the Colombian government recently introduced a land-grant program that creates incentives for farmers to increase the area planted to oil palm in Tumaco.

CIAT has also worked with flower producers to solve specific disease problems of orchids and roses. And now it is looking into the immense potential of tropical fruit trees and shrubs as sources of income for poor farmers. These include passion fruit, papaya, guanabana, lulo, avocados, and blackberries. Among other things, researchers are using molecular marker techniques to characterize the genetic diversity of selected fruit species, developing methods for rapid multiplication and in vitro storage, and detecting and identifying viruses. In addition, CIAT specialists in agroenterprise development are exploring the technical and economic feasibility of tropical fruit production for small farmers.

By tapping its considerable expertise with more traditional crops, CIAT is helping open up alternate paths to small-farmer prosperity. Private-sector support is essential for the strategy to work.



CIAT research assistant Sandra Lorena Reyes inoculates oil palm plants with *Ceratocystis paradoxa* (the pathogen of the most important disease of this crop) in a growth chamber at Center headquarters.



A blooming flower industry

CIAT staff recently worked with Colombia's orchid producers association to sort out a potentially disastrous problem. The growers had imported breeding material from Asia which, after inspection by national authorities, was declared to harbor bacteria not native to Colombia. They were asked to burn the imported plants as a precaution.

In desperation the growers asked for CIAT's help. "They told me that if they were forced to destroy the imported stock, they would go out of business," recalls CIAT plant pathologist Elizabeth Alvarez.

The CIAT scientist isolated the pathogen and replicated the symptoms in test plants. Her results showed that the bacteria was not exotic and therefore not a new threat to Colombia. Alvarez also collaborated with Colombian authorities, running biochemical tests on their bacterial isolates. The diagnosis was confirmed: the pathogen was one commonly found in Colombia, though somewhat similar to the suspected exotic strain.

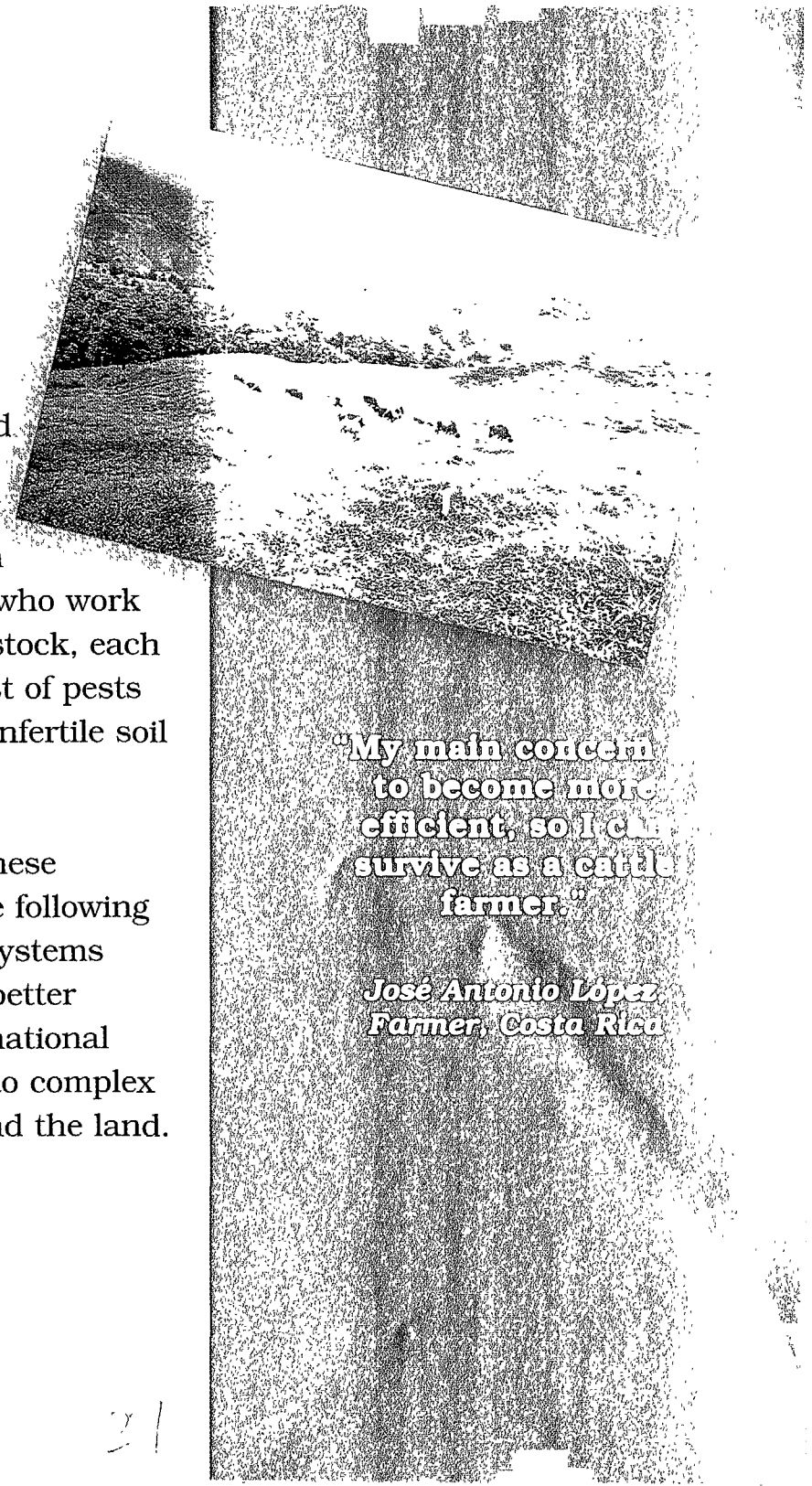
In the end, the imported orchids—and jobs—were saved. CIAT gave the orchid growers advice to prevent the spread of the bacteria and, more important, guidelines on sanitary vegetative propagation. "Now, their flower business is literally blooming," says Alvarez. "They've even expanded the operation."

Farmers in the Sepaku area of East Kalimantan, Indonesia, are experimenting with improved forages to reclaim degraded land for cattle production.

Solutions with a Systems Perspective

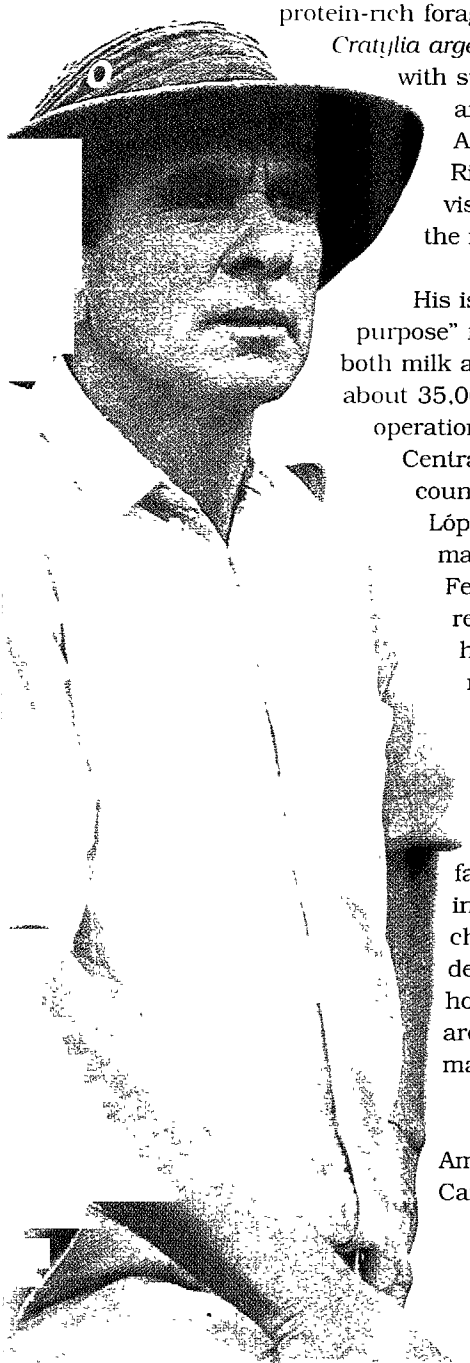
A stroll through a small farm in a developing country will generally confirm, even to the untrained observer, the complexity of smallholder production systems. These frequently occupy marginal land, sometimes steep slopes or forest margins best left in natural vegetation. More often than not, the people who work this land are poor. They raise a mix of crops and livestock, each with multiple uses in the household economy. A host of pests and diseases may attack crops already weakened by infertile soil and insufficient rain.

Designing solutions to reduce poverty under these circumstances is not easy, but it can be done. As the following examples show, CIAT seeks solutions through a systems approach that links improved germplasm with better management of natural resources. Working with national partners, we help poor farmers fit new technology into complex systems, so they can improve production, incomes, and the land.



Formidable forages

José Antonio López has just finished feeding his cows their daily ration of a protein-rich forage legume, *Cratylia argentea*, mixed with sugarcane. The animals love it. And the Costa Rican farmer is visibly happy with the mixture too.



His is a "dual-purpose" farm, producing both milk and beef—one of about 35,000 such operations in this Central American country. On the López farm, milk is made into cheese. Female calves remain with the herd, while males are sold after weaning to be fattened for the beef market. Other dual-purpose farmers sell milk instead of cheese, depending on how close they are to local markets.

In Latin America and the Caribbean, small farms of this type abound. They account for nearly 80 percent of total livestock and about 40 percent of milk production. They are a key link in the regional economy and food chain.

But a grave threat looms. Of the region's 590 million hectares of pasture land, about half is thought to be in an advanced state of environmental degradation. Better technological options are needed if poor farmers are to reverse the damage and boost productivity in response to growing international competition.

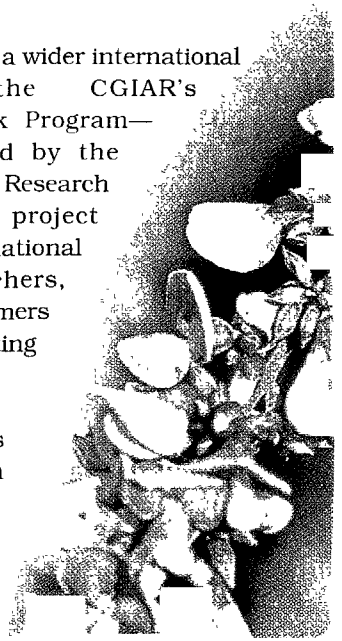
López now sits on a milking stool in the shade of his livestock feeding station—a few minutes' respite from the late morning February sun. Armed with a pen and a clipboard full of production data, he does some quick arithmetic to answer visitors' queries about farm economics.

Last year, he reckons, his "forage bank" of *Cratylia*, now occupying more than a hectare of previously degraded land, cut his farm costs by an amount equivalent to one-third of his annual after-cost farm income. The large savings came from no longer having to buy chicken manure, a typical feed supplement used from December to May. That is the dry season, when pastures offer cows little greenery to eat and are especially susceptible to overgrazing and soil compaction. But with increasing vegetable production in the country, demand for chicken manure as organic fertilizer has skyrocketed and, along with it, the price.

For López, cut-and-carry *Cratylia* turned out to be an ideal low-cost substitute that he can produce on site. It has also reduced grazing pressure on pastures and allowed an otherwise useless plot to be rehabilitated and put to good use. Besides that, the extra forage has allowed López to take several hectares of pasture out of production and plant trees instead. As part of the reforestation effort, he protected a hillside spring. He has even noticed an increase in the number of birds and mammals on the farm. "We're also seeing more butterflies—and snakes too," he says with a laugh.

Cratylia is a shrub native to South America. CIAT has been experimenting for some years with this and other legumes as well as forage grasses. Now, through a network-based project called Tropileche, set up in 1996 and coordinated by CIAT, scientists and producers like López are testing promising new combinations on-farm in Costa Rica, Honduras, Nicaragua, and Peru. Funding is provided by the Inter-American Development Bank (IDB) and German Agency for Technical Cooperation (GTZ).

Tropileche is part of a wider international research effort—the CGIAR's Systemwide Livestock Program—which is coordinated by the International Livestock Research Institute (ILRI). The project brings together international and national researchers, extensionists, and farmers from the four participating countries.

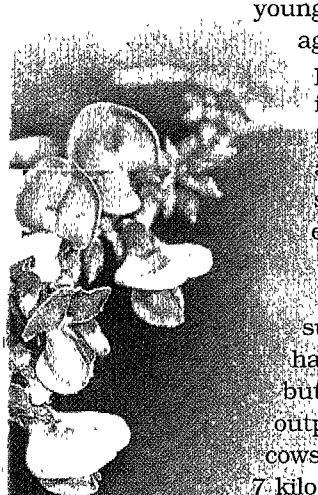


The dry season poses serious production problems, typical of

those seen on many dual-purpose farms in Central America's hillsides, explains CIAT consultant Pedro Argel. Naturalized pastures, mostly African grasses introduced centuries ago, do not thrive. Milk production goes down, and animals sometimes become sick and die. Family income is often precarious. López knows the routine well.

Two main *Cratylia* feeding systems are under study. The shrub can be planted as a forage bank, as López has done. Daily feed rations are cut and put through a shredder with sugarcane. One part *Cratylia* provides the protein, two parts sugarcane the energy component.

Alternatively, *Cratylia* can be grown directly in pastures for grazing animals to feed on. In reforested areas, it can be planted around young trees to protect them against browsing. The pasture-planting method is an advantage for poor farmers who cannot afford motorized shredders or do not have electricity.



For López, the *Cratylia*-sugarcane supplement has not only cut feed costs but has also boosted milk output. In the dry season, cows now give up to 7 kilograms daily. In years past it was as low as 1.5 kilograms. Animal mortality has also gone down, and López is now selling *Cratylia* seed to neighbors. Legume forage production also fits well with the family cheese-making operation, run by Lopez's mother. From 40 kilograms of milk a day, she produces 4.5 kilograms of cheese.

Cratylia is just one of several forage species being tested on-farm by Tropileche. Others include *Arachis pintoi* (a legume related to the peanut), which is planted directly in pastures and stands up to heavy grazing in association with the African grass *Brachiaria*. Together, they provide high-quality feed and a thick ground cover, which maintains soil moisture and prevents erosion.

For dual-purpose farmers like López, the future is still uncertain despite improvements. By 2004, duties on imported milk products will be gradually cut from the current 111 percent to 30 percent, forcing Costa Rican producers to be more competitive or get out of cattle raising. "Economic globalization is bad business for small- and medium-scale farmers," López believes. "But we'll face the changes as well as we can."

Costa Rican farmer José Antonio López has established a forage bank of *Cratylia argentea* to improve his livestock productivity in the dry season and reduce grazing pressure on fragile hillside land.

Stepping stones out of poverty

Southeast Asia's highland farmers see livestock as a stepping stone—a way out of the tightening cycle of poverty caused by declining returns from traditional slash-and-burn cultivation. Cattle and buffalo provide manure to sustain crop yields. And unlike most crops, animals can be sold at any time for a stable price. Unfortunately, livestock production is suffering a fate similar to that of shifting cultivation: resource depletion. Grazing land is becoming scarce or over-used. Forage for animals is a hard-won prize.

Slash-and-burn cultivation on steep hillside land in Southeast Asia.

"Many upland farmers in Southeast Asia now face a stark dilemma," says Peter Horne, an agronomist with the Forages for Smallholders Project (FSP). "To improve their lives, farmers want to continue raising livestock. But they need to use more labor to cut feed or to take their animals far from the villages to graze." In Ta village, northern Laos, for example, women and children spend up to 3 hours a day cutting grass for their livestock.

FSP is jointly coordinated by CIAT and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia and is funded by the Australian Agency for International Development (AusAid). The national partners involved in the project use participatory research approaches with farmers in Indonesia, Laos, Philippines, Thailand, and Vietnam. Together, they develop and test forage systems to overcome livestock feeding problems. Broadly adapted grasses and legumes are the key biological ingredients in these new systems.

"Developing forage systems is not simply a matter of introducing species and then walking away," says Horne. Initially, farmers were cautious, preferring to evaluate a few species in small plots. As they became familiar with the plants and confident in FSP's ongoing assistance, they began experimenting with other forage species.

"My friends thought I was crazy when I first started planting grasses to feed my cattle," explains a participating Vietnamese farmer. "But now they see the benefits and have been asking me for cuttings to plant on their own farms." The fact that forages require little or no cash investment and can be multiplied locally using seed or cuttings is of immense benefit to poor farmers.

"The challenge now," says Horne, "is to expand the impact of these benefits by developing new approaches that will allow us to work with much larger numbers of farmers in a participatory framework."

Asia's cassava bonanza

Cassava is a faithful friend to the 500 million people worldwide who depend on its starchy root for food and cash. The crop survives in the poorest of soils and has remarkable drought tolerance But this "crop of last resort" is also proving to be an economic dynamo, particularly in Southeast Asia, supplying much more than food security to the rural poor.

Although cassava (*Manihot esculenta* Crantz) originated in Latin America, centuries ago Portuguese sailors brought it to Africa, then Asia. While cassava still occupies an important place on dinner plates in much of the developing world, increasingly it is grown as raw material for starch production and animal feed. In the process this versatile plant is giving millions of small farmers a

chance to tap commercial markets and turn their back on poverty.

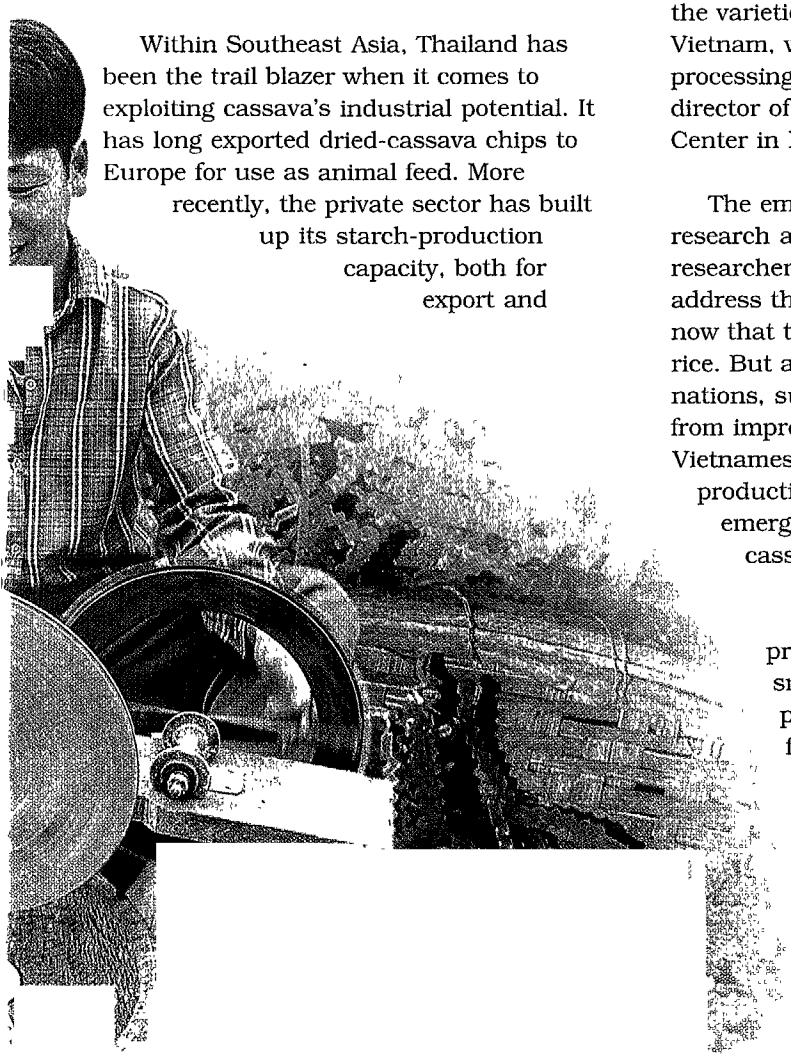
In Southeast Asia 25 improved cassava varieties have been developed and released through collaboration between CIAT and national programs belonging to the Asian Cassava Research Network. Rich in starch and high-yielding, the new varieties are planted on an estimated 880,000 hectares (mostly in Thailand, Indonesia, and Vietnam), generating economic benefits estimated at US$245 million.

Within Southeast Asia, Thailand has been the trail blazer when it comes to exploiting cassava's industrial potential. It has long exported dried-cassava chips to Europe for use as animal feed. More recently, the private sector has built up its starch-production capacity, both for export and domestic use. As a result of intensive efforts by the Thai Department of Agricultural Extension, about 63 percent of the country's main cassava areas are now planted to four new varieties developed by the Field Crops Institute with CIAT support.

Vietnam is following that lead. By 1997 the new materials covered about 10 percent of its cassava area, with producers seeing yield increases of 20 to 40 percent. "Especially enthusiastic about the varieties are the farmers of southern Vietnam, where most of our starch processing takes place," says Hoang Kim, director of Hung Loc Agricultural Research Center in Dong Nai Province.

The emphasis now being put on cassava research and development by Vietnamese researchers is an earnest attempt to address the needs of poor upland farmers now that the country is self-sufficient in rice. But as in other Southeast Asian nations, sustaining the economic bonus from improved germplasm will depend on Vietnamese farmers boosting their production efficiency and on the emergence of diverse markets for cassava-based products.

In the country's north, starch production is still dominated by small rural enterprises. The primary use of cassava, though, is feed for pigs, chickens, ducks, and pond-raised fish. As meat demand rises, small farmers are gradually increasing their incomes by chipping and drying more cassava. Improved varieties are helping to make that shift possible, feasible, and profitable.



The spread of small- and large-scale cassava processing in Vietnam and other Southeast Asian countries creates new economic opportunities for poor farmers in upland areas.

In Indonesia cassava is still valued primarily for its contribution to the human diet.

Nguyen Thi Sau is taking advantage of the new varieties. She lives with her husband and two children in the hamlet of Dong Tom in the hills of northern Vietnam. While Mr. Sau has a job with the municipality, Mrs. Sau runs their tiny farm, a mere half hectare. Like many other small-scale farmers in this area, she not only grows cassava but also raises livestock: pigs, chickens, and fish.

Seven years ago she began participating in on-farm trials of the improved cassava varieties. The experiments were organized by the Vietnam Agricultural Science Institute (VASI), a CIAT partner since 1990.

For over a decade, the Japanese government has been a key financial supporter of CIAT work of this type, in both Asia and Latin America.

The results of the cassava trials changed Mrs. Sau's life. She adopted two improved varieties, called KM60 and KM94. The combination of better genetic material and use of commercial fertilizers (along with animal manure she has always applied) boosted production dramatically.

With the extra harvest, Mrs. Sau dried more cassava chips to feed her livestock, and she successfully expanded her pig operation. The extra cash allowed her to buy and maintain a second-hand motorcycle. A TV set followed and, eventually, the added revenues helped the family build a new house.

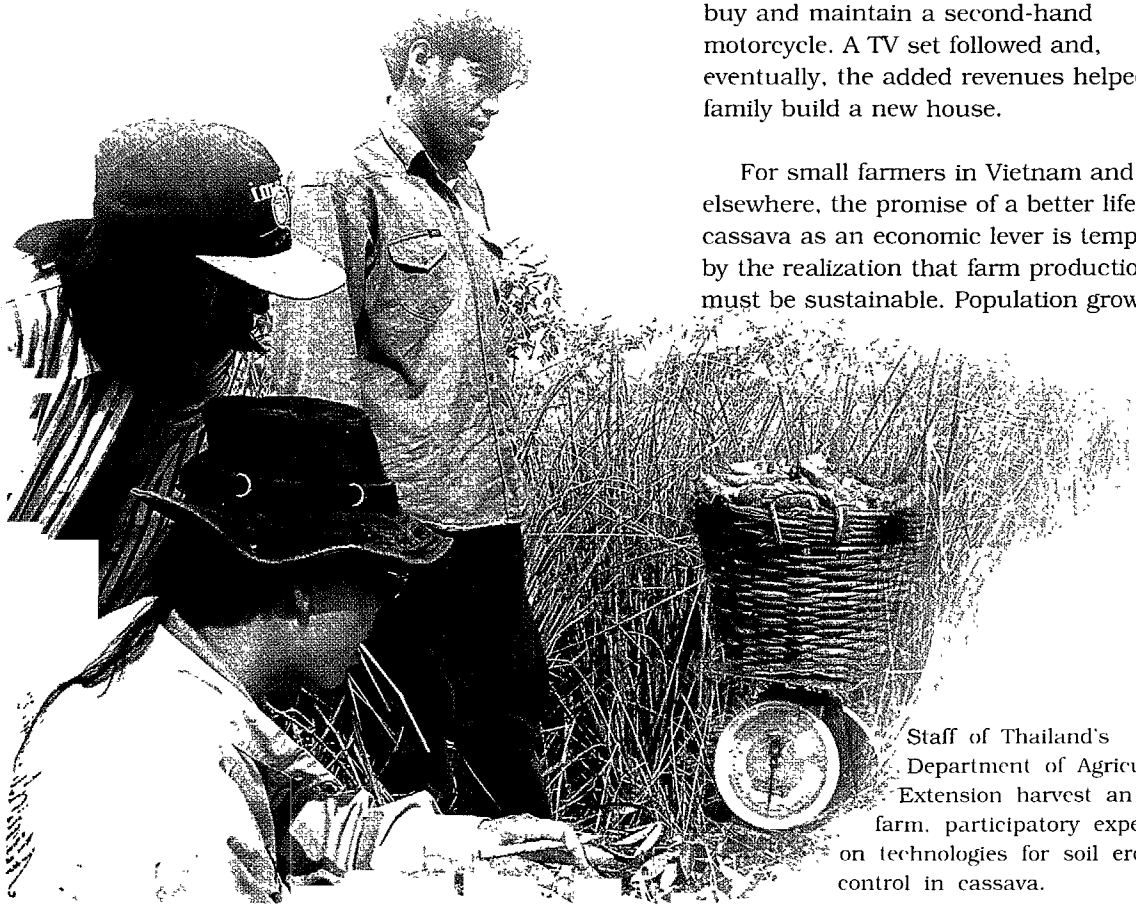
For small farmers in Vietnam and elsewhere, the promise of a better life using cassava as an economic lever is tempered by the realization that farm production must be sustainable. Population growth and intensified cropping are putting pressure on vulnerable areas such as Thailand and Vietnam's uplands. Soil fertility and erosion are big stumbling blocks. "For any soil conservation method to be adopted, farmers have to be motivated and have extra cash for investment," says Kasuo Kawano, former CIAT cassava breeder.

In Mrs. Sau's case, extra manure from pig production goes back into the soil to maintain fertility. But other resource management methods are also available, promising, and now being tested and adopted by farmers.

Supported by Japan's Nippon Foundation, CIAT is now working closely with national institutes and farmers in four Southeast Asian countries to find solutions. Farmers at more than a dozen pilot sites have been fully involved in soil protection experiments since 1995.

A variety of technical options are being tested. Cassava is planted on ridges across rather than down slopes. It is being intercropped with peanuts for better ground cover (and another source of income). And contour hedges of vetiver grass and the legume *Tephrosia* are providing "live" barriers against erosion caused by rain.

One conclusion so far is that farmers strongly prefer soil conservation practices that generate income. For example, for anti-erosion hedgerows, they like to plant species that have cash value, like sugarcane and lemon grass, or can be used



Staff of Thailand's Department of Agricultural Extension harvest an on-farm, participatory experiment on technologies for soil erosion control in cassava.

as animal fodder or green manure. An overall conclusion of a 1998 project evaluation showed that participating farmers find the soil management practices do succeed in reducing erosion and boosting crop yields and income.

In a second project phase, more farmers and more test sites will be included in the research, especially in Thailand and Vietnam. With strong emphasis on farmer participation in research as well as extension, the researchers hope to expand the impact of their work, making cassava a sustainable and profitable crop for many more poor farmers in Southeast Asia.

Recipes for successful agroenterprises

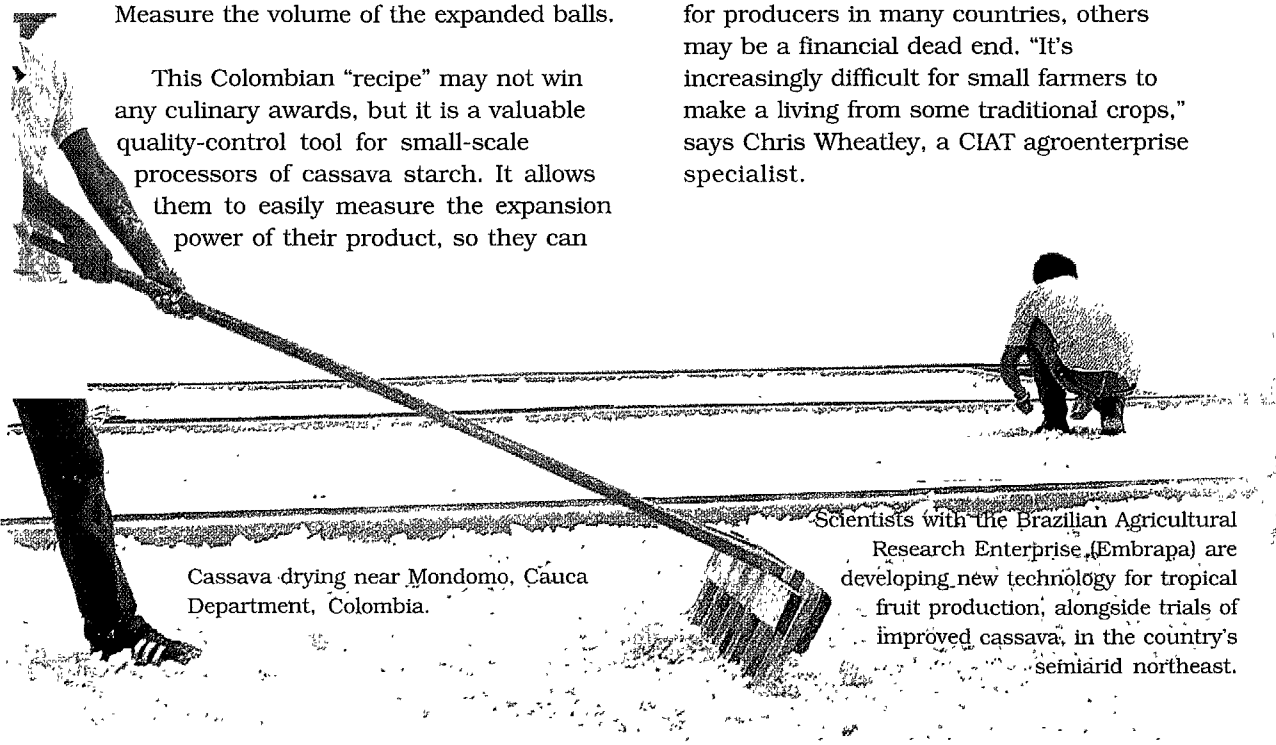
Mix 10 grams of sour starch with 12 grams of water. Knead and shape the dough into six balls the same size. Pop in the oven and bake 25 minutes at 290 degrees C. Measure the volume of the expanded balls.

This Colombian "recipe" may not win any culinary awards, but it is a valuable quality-control tool for small-scale processors of cassava starch. It allows them to easily measure the expansion power of their product, so they can consistently meet the market requirements of consumers, bakers, and other food industry clients. This simple "protocol" was designed recently with the participation of starch processors and their clients in a project carried out by CIAT, France's Center for International Cooperation in Agricultural Research for Development (CIRAD), and two Colombian institutions, the University of Valle and the Corporation for Interdisciplinary Studies and Technical Assistance (CETEC). The project was designed to strengthen the cassava starch industry in Colombia's Cauca Department. It is just one among many efforts supported by the Center's rural agroenterprise development project to help small-farm communities add value to crops and other farm products, such as milk.

While some traditional staples like cassava offer lucrative new opportunities for producers in many countries, others may be a financial dead end. "It's increasingly difficult for small farmers to make a living from some traditional crops," says Chris Wheatley, a CIAT agroenterprise specialist.

He cites the case of wheat in Colombia. Only about 5 percent of the country's needs are met by domestic production; the rest is imported. Despite the minor role of wheat cultivation in the economy, many poor farmers, like those in Nariño Department, still depend on the crop for a living. These people, says Wheatley, need a wider menu of options.

Colombian wheat is not an isolated case. Alternative crops and new ideas for processing and selling traditional commodities profitably are desperately needed by rural communities around the world, especially as global trade patterns change. "We have to look at enterprises



Cassava drying near Mondomo, Cauca Department, Colombia.

Scientists with the Brazilian Agricultural Research Enterprise (Embrapa) are developing new technology for tropical fruit production, alongside trials of improved cassava, in the country's semiarid northeast.

that will give a bigger quantum step in income," says Rupert Best, leader of CIAT's agroenterprises project.

New options not only put more money in the pockets of the poor, but they also give small farmers the resources and motivation to invest in sustainable farming practices and conservation of natural resources. This is especially important in fragile ecosystems.

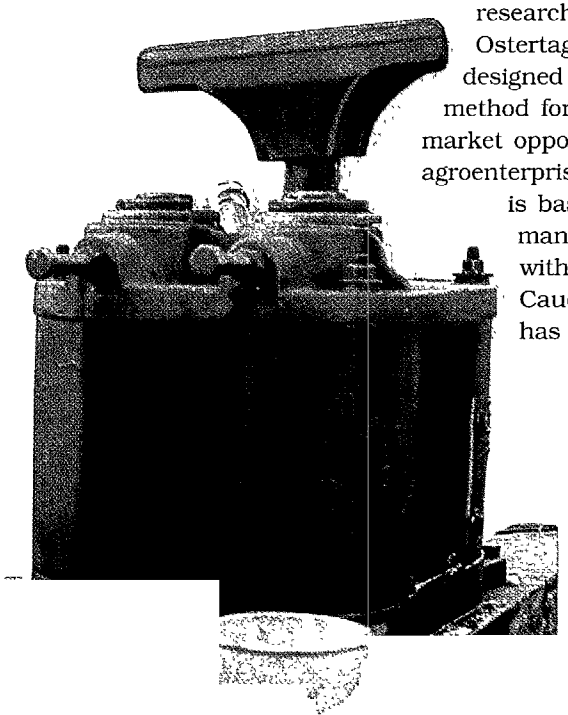
But for that to happen, say Wheatley and Best, an integrated approach to enterprise development is needed. This should take into account the market potential of new products, the suitability of available processing technologies, and the organization of enterprises and their support services. These factors, in turn, should be seen in light of community needs, especially those of women, who are often the key players in postharvest practices.

Over the past decade, CIAT and partner organizations like CIRAD have learned a lot from their cassava improvement work and research into related processing. Now CIAT is applying that experience to alternative crops, including tropical fruits, in cooperation with institutions in Bolivia, Colombia, Ecuador, and Venezuela.

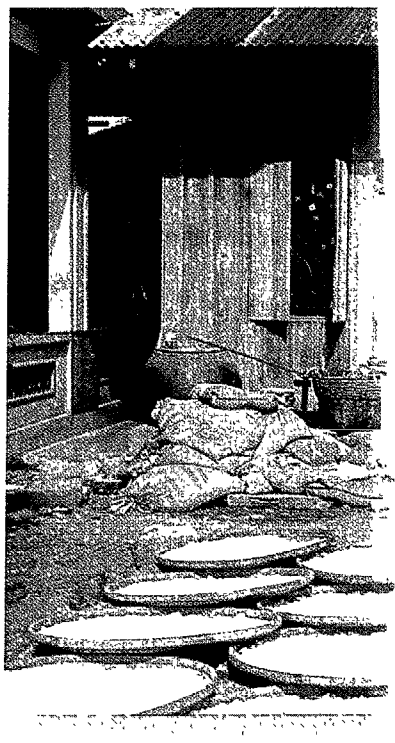
CIAT's approach is not to concentrate on the nuts and bolts of individual production or processing technologies, though in some cases that is important. Rather, the overriding goal is to formulate new methods, decision-making tools, and information that can help other organizations and community groups to develop a range of viable new agroenterprises linked to growth markets. In this sense CIAT is producing "public goods" capable of having wide impact.

For example, CIAT researcher Carlos Ostertag recently designed a general method for identifying market opportunities for rural agroenterprises. Although it is based on CIAT's many years of contact with farmers in Cauca, the method has been adapted for use in other places as well, based on work at representative sites in Peru and Honduras. A companion training manual has also been produced. It was recently tested at workshops in Honduras and Nicaragua and will be used later this year at a similar event in Africa.

A major bottleneck in agroenterprise development is the incipient state of international market channels for alternative tropical products. Buyers and sellers simply are not very aware of each other. A CIAT search of the Internet in 1998, for example, showed there is not even a well-developed database on the trade of such goods. This contrasts sharply with the situation for mainstream exports like Latin American coffee, which, despite ups and downs, has established a solid international position. What true-blue



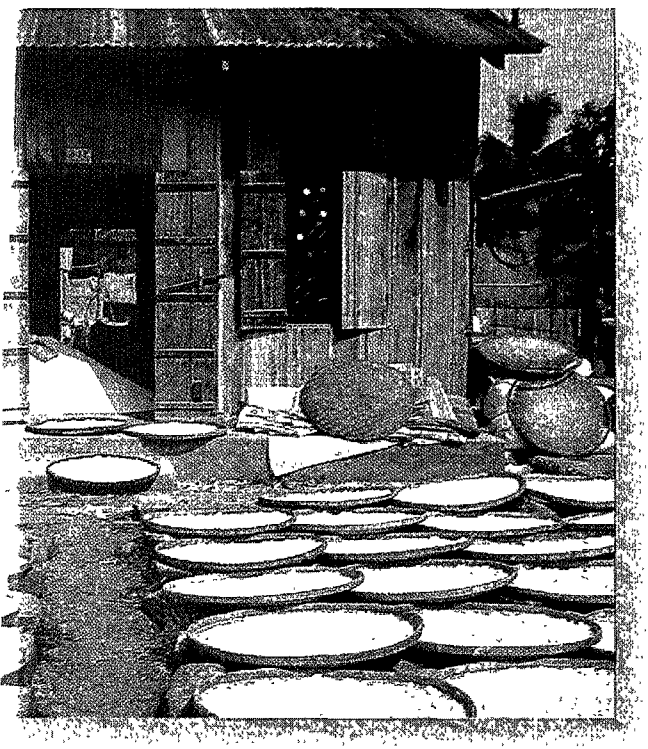
Sugarcane processing in central Nicaragua.



Drying cassava starch in China.

coffee connoisseur is not familiar with the well-cultivated image of poncho-clad Juan Valdez riding his burro to market?

To help fill the gap, CIAT is designing an information system on alternative farm products, relevant trade bodies, regulations, and services. Its contents are now being compiled and should soon be available on the Center's Web site. The service will include a list of contacts within the alternative trade chain, a description of market trends, and announcements of relevant trade fairs worldwide. Center staff will regularly update the information and share it with organizations that promote rural entrepreneurship, such as the Program for Rural Agroindustrial Development (PRODAR), a cooperative program for Latin America and the Caribbean.



A recent impact study of CIAT work in Brazil, related to processing of cassava into animal feed, provided interesting insights about how best to promote sustainable small rural enterprises. A key conclusion was that the integration of activities—production, processing, and commercialization—was indeed a sound approach. More than 95 percent of the economic benefits stayed in the community, with the lion's share going to small producers. According to women surveyed for the study, the extra money they earned from cassava processing enabled them to buy household items and clothes and shoes for their children.

Such results demonstrate that CIAT's holistic approach to agroenterprise development is on the right track. The challenge now is to formalize and share that knowledge on a wider scale.

Battling the whitefly

"Whitefly is one of the most important problems we're facing in tropical agriculture," says Pamela Anderson, a CIAT entomologist and coordinator of the global Whitefly Integrated Pest Management (IPM) Project. It is common to have total crop failure. In Central America beans, tomatoes, and cotton have all been severely affected by whitefly problems."

Insecticides are applied with alarming frequency on bean crops in Colombia's Antioquia Department to control whitefly and other pests.

Of more than 1,150 known species of whitefly, at least seven are serious threats. They attack crops directly and aggressively, transmit disease-causing viruses, or both. But the undisputed storm trooper of the world's growing army of whiteflies is a species called *Bemisia tabaci*. Besides being a direct pest by sucking sap from plant foliage, this whitefly is also a vector of "geminiviruses"—organisms that cause some of the most damaging diseases known to agriculture.

The whitefly menace is complex—biologically, socially, economically. And it is getting worse. Although *Bemisia tabaci* has been recognized as both a pest and disease vector for over a century, damage tended to be limited to a few crops and geographic areas. But over the past decade or two, that pattern has changed drastically.

Whiteflies and the viruses they transmit now damage many crops, both food staples and cash crops. Among its favored targets are beans, tomatoes, cassava, cotton, peppers, melons, squash, cabbage, eggplant, tobacco, and broccoli. And the viral diseases they transmit have extended their geographic range as well as the number of target host crops.

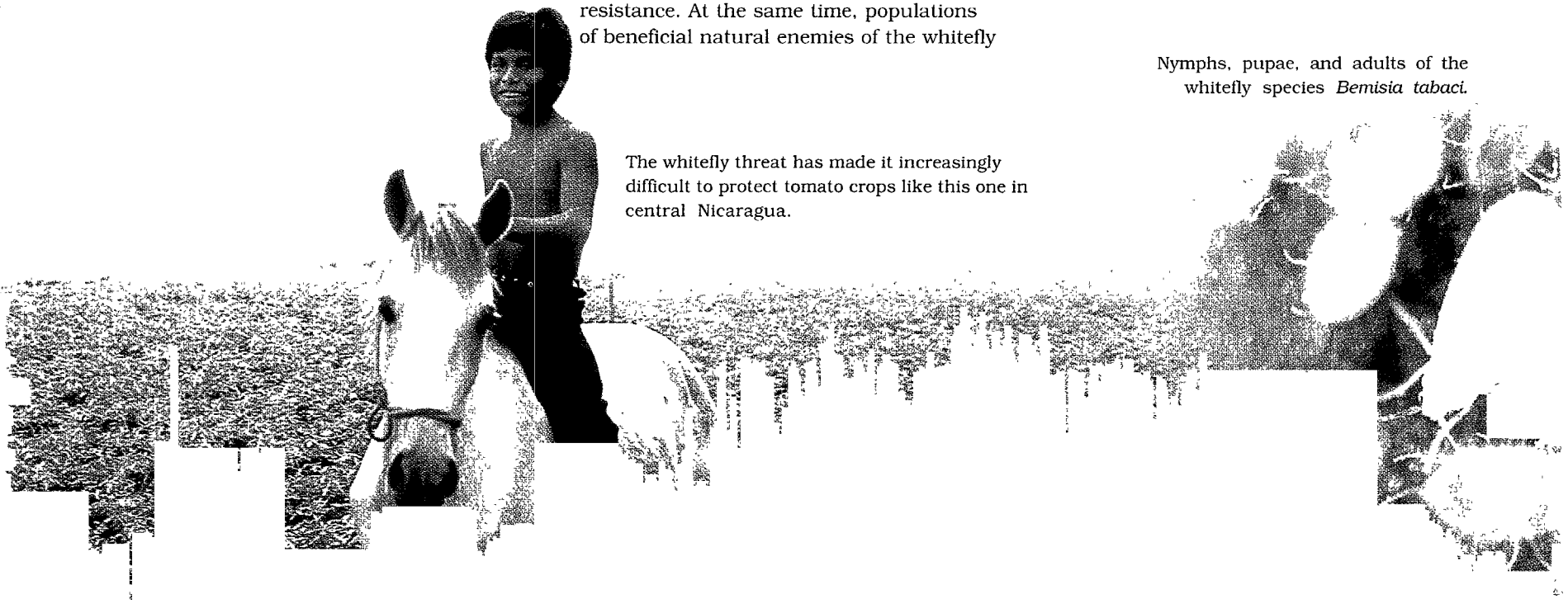
Among the reasons for the growing whitefly threat are crop diversification and, ironically, the boom in pesticide use, particularly in Latin America. Demand for vegetables and other cash crops is on the rise, and farmers in the tropics have capitalized on the trend to boost their incomes. "The fact that cropping systems have become more complex because of these international economic forces means that the whitefly too has become more important," says Anderson.

The heavier investment required for cash crops, plus market demand for high-quality, unblemished products, has motivated farmers to apply more pesticides. One study showed that some bean farmers in Colombia spray up to 24 times per crop cycle. Intensive pesticide use on horticultural crops is now quite common in Africa too.

With growing pesticide use, explains Anderson, whiteflies have developed resistance. At the same time, populations of beneficial natural enemies of the whitefly have dwindled. With the ecological balance upset, the way is clear for more whitefly attacks. This simply induces desperate farmers to spray even more, causing further contamination of soil and water and jeopardizing the health of consumers and farm workers.

With funding from Danish International Development Assistance (Danida), the global Whitefly Project began operations in Latin America and Africa during 1997 under CIAT coordination. The project is part of the CGIAR Systemwide IPM Program, which aims to develop and promote IPM approaches across the developing world.

With a problem as complex as whitefly, a coordinated, multidisciplinary, pan-tropical approach is critical, says Anderson. But before scientists can design



The whitefly threat has made it increasingly difficult to protect tomato crops like this one in central Nicaragua.

Nymphs, pupae, and adults of the whitefly species *Bemisia tabaci*.

effective IPM weapons, they need precise answers to difficult questions: How much damage is being done to which crops? How are whitefly-transmitted viruses spreading within and between crops? While scientists already know a lot, the picture is far from complete.

Until the Whitefly project was set up, "there was no integrated overview of the problem," says Anderson. "We couldn't answer certain questions." The first phase of the project, now complete, has put in place the necessary links to overcome that hurdle.

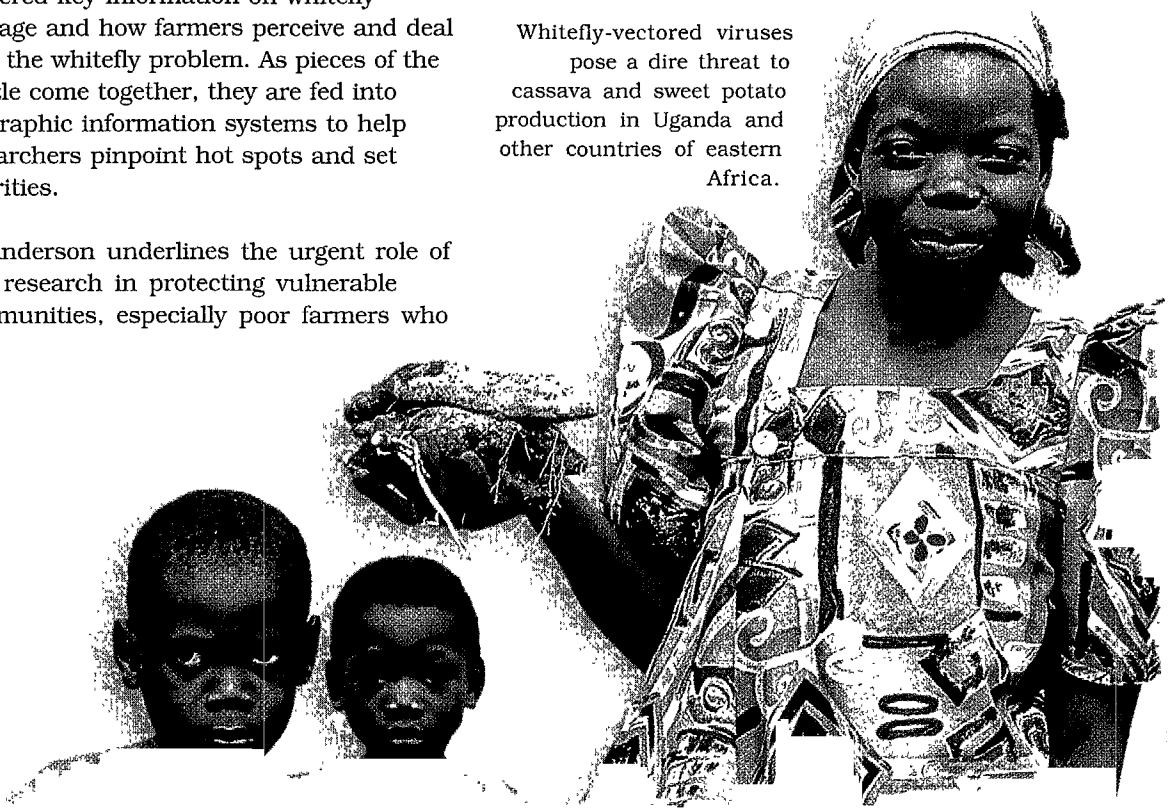
The project network brings together experts from five international centers and 55 national institutions in 30 Latin American, Caribbean, African, and Asian nations. Several advanced research institutes in industrial countries are also contributing.

Asian participation, a new link in the scientific chain, is funded by the Australian Centre for International Agricultural Research (ACIAR). Further components—to fight cassava mosaic disease in Africa and to study the genetics of cassava resistance to whitefly—have also been added thanks to funding from the US Agency for International Development (USAID) and New Zealand's Ministry of Foreign Affairs and Trade. The US Department of Agriculture (USDA) and the Food and Agriculture Organization (FAO) are planning to join the project's constellation of partners by the end of 1999.

In 2 years the project has achieved plenty. Research methods have been standardized, and field studies have gathered key information on whitefly damage and how farmers perceive and deal with the whitefly problem. As pieces of the puzzle come together, they are fed into geographic information systems to help researchers pinpoint hot spots and set priorities.

Anderson underlines the urgent role of this research in protecting vulnerable communities, especially poor farmers who rely on food crops like cassava and beans. "People's staple foods are being devastated by this pest. In eastern Africa in the late 1980s and early 1990s, we had starvation and deaths because of cassava viruses transmitted by whitefly. In this day and age, problems like this are almost unheard of." Because of a grave viral epidemic in East African cassava fields, the project has stepped up control efforts there. This work focuses on the use of resistant varieties to slow the spread of cassava mosaic disease and buy time to implement other IPM alternatives.

"The synergy of the collaboration is what's driving the overall project," says Anderson. "I never dreamed this was going to take off so fast."

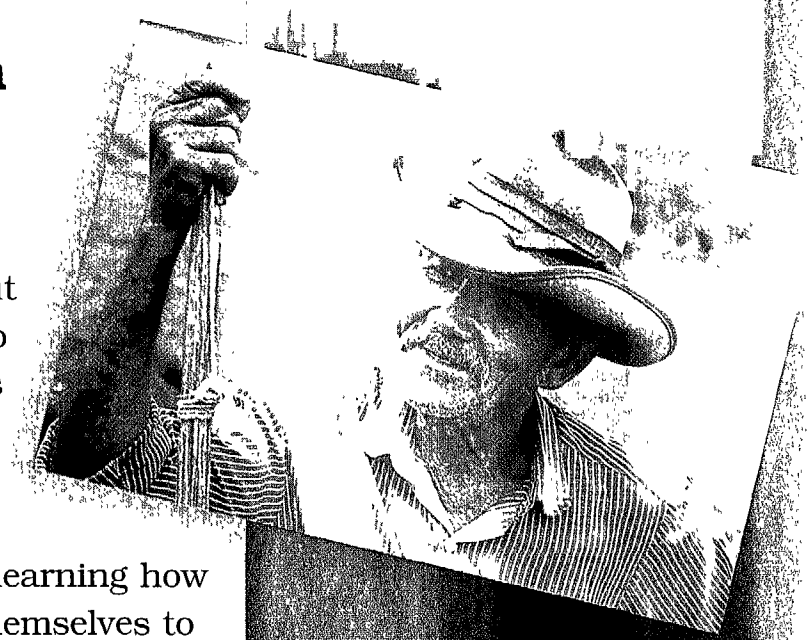


Whitefly-vectored viruses pose a dire threat to cassava and sweet potato production in Uganda and other countries of eastern Africa.

Bertha Adilia Jarquín, a community leader involved in participatory research at San Dionisio, Matagalpa Department, Nicaragua

Rural Empowerment Through Participation

People do not like being left on the sidelines. But finding effective ways for them to put their ideas to work and seize opportunities to better their lives is rarely easy—especially when they have grown accustomed to the deaf ear of chronic neglect.



CIAT and its national partners have spent a decade learning how rural communities in Latin America can organize themselves to conduct their own agricultural research with a modest amount of technical support. The impact is highly encouraging. Farmers working through local research committees are producing useful results and stimulating technology adoption and further experimentation. The model has now spread to eight countries.

Center staff and local partners are also applying participatory approaches to community management of natural resources—soil, water, and forests—in vulnerable hillside areas of Colombia, Honduras, and Nicaragua. New grass roots organizations are now out to turn forgotten communities into empowered agents of change and foes of poverty.

"I have woken up as a farmer and as a researcher. I can contribute to decision making in our community, and I feel able to lead this community organization."

Ernesto Quintanillo, Leader of a local agricultural research committee (CIAL) in Honduras

Traditional wisdom meets formal science

Poverty can be defined as the denial of opportunities to build an adequate livelihood. For millions of poor rural people, the limited options open to them center on agricultural production and consumption—work and survival. What crops or crop varieties should we grow? What are the best techniques for cultivating them? How can the harvest be put to best use?

Unfortunately, the solutions are not always ideal. They may come from local knowledge systems unable to deal with problems such as population growth and environmental degradation. Or they may come from well-intentioned outside "experts," who are nevertheless inadequately informed about farmers' needs and preferences. Farmers' choices may turn out to be extremely narrow, opportunities limited. Thus, poverty retains its grip.

But when poor farmers seize the chance to make decisions themselves, to exploit the best of traditional wisdom and formal science, they take a crucial step on the slow path to prosperity. Ann Braun, manager of CIAT's participatory research project, refers to this as *autogestion*, the Spanish word for self-management. For her, it implies not only making decisions but also mobilizing the necessary resources—knowledge, labor, money, community spirit.

CIAL is the Spanish acronym for local agricultural research committee. For Braun, this highly successful innovation embodies *autogestion*. "The outcomes of our experiments with this approach have astonished and delighted us," says Braun. "By taking charge of the research process, farmers experience a new sense of purpose in life . . . . They see research as an opportunity to escape from poverty and to help others in their community. And they seize that chance with both hands. They are, in short, empowered."

This Nicaraguan farmer is taking part in a new, participatory approach for developing and evaluating agricultural production technologies.

With the CIAL approach, the community is in the driver's seat. Representatives from a professional organization serve as animators when a CIAL is first being set up and later as technical advisers. But local residents make all the strategic decisions. These include whether to form a CIAL in the first place, which agricultural problem or opportunity should receive highest priority, and who should represent them on the local committee.

The CIAL model, whose development has been consistently funded by the W.K. Kellogg Foundation, had its first real test run in 1990. CIAT worked with communities in Colombia's Cauca Department to set up five pilot CIALs. Since then, the model and related training materials have been fine-tuned, and the idea has spread elsewhere in Colombia and to seven other countries: Bolivia, Brazil, Ecuador, El Salvador, Honduras, Nicaragua, and Venezuela. By early 1999, more than 250 CIALs had been formed in Latin America. The Colombian Corporation for Agricultural Research (CORPOICA) is particularly keen on this type of farmer participatory research. In 1998 it announced a plan to apply the CIAL approach countrywide.

A CIAL is normally composed of a minimum of four community members. They should be active farmers and seasoned experimenters willing to share time, energy, and information with neighbors. CIAL formation begins with a "motivational" meeting to which the whole community is invited. It is organized by a

host agency well versed in the CIAL approach, usually a research institute, extension service, or nongovernment organization (NGO). A facilitator explains the basics of agricultural experimentation, risks and rewards, what a CIAL's job is, and how it is structured.

If and when the community agrees on its research priority and committee membership, an agronomist or farmer-facilitator trained in the basics of research and CIAL methods helps the elected farmer-researchers identify technological options for experimentation and adaptation. For example, if better fruit production is the goal, experiments could center on options for organic fertilizer application.

The technical adviser from the host agency helps the CIAL with experiment design. The research normally proceeds in three phases. The scale of experiments—for example, plot size—increases with each phase. Where farmers give technical support, they have access to advice from agronomists.

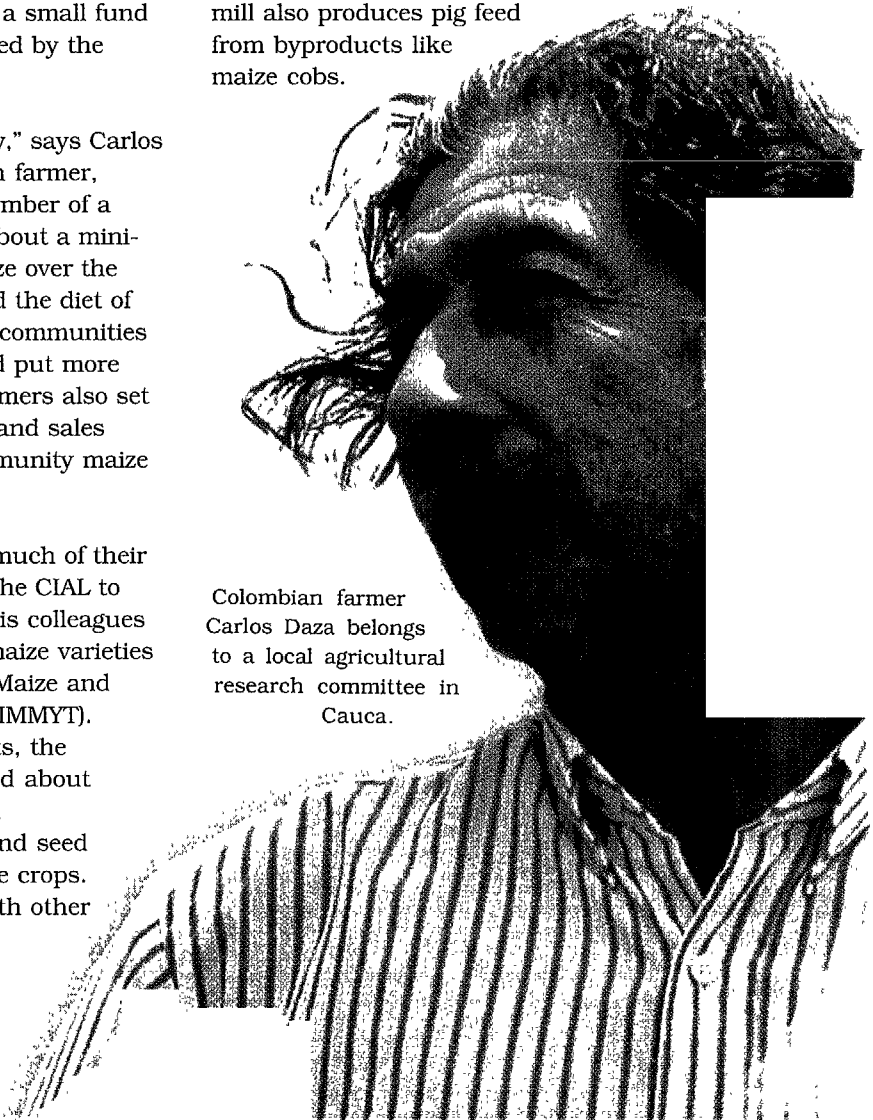
Establishing priorities for local agricultural research through a community consultation in Colombia's Cauca Department.

At the end of each phase, the CIAL team consults with the technical expert to draw conclusions from the results. This guarantees a two-way flow of information between the CIAL and the research or extension organization supporting it. Later, the CIAL presents its data and recommendations to the community. Financial risk is minimized by a small fund managed by the CIAL but owned by the community.

"Our situation is better now," says Carlos Daza, a 61-year-old Colombian farmer, husband, father of 10, and member of a CIAL in Cauca. He is talking about a mini-boom in the cultivation of maize over the past few years. It has improved the diet of more than 100 families in the communities of Pedregal and San Bosco and put more pesos in their pockets. The farmers also set up their own seed production and sales operation and installed a community maize mill.

The two communities owe much of their recent success to the work of the CIAL to which Daza belongs. He and his colleagues experimented with improved maize varieties provided by the International Maize and Wheat Improvement Center (CIMMYT). During the varietal experiments, the researcher-farmers also learned about fertilization, planting methods, environmental conservation, and seed selection and storage for future crops. This knowledge was shared with other farmers.

"The CIALs have helped us improve our standard of living," says Daza. Now that productive maize cultivation is well established in the two communities, farmers have surplus grain to raise chickens, pigs, and fish for home consumption or sale. And the extra chicken manure, says Daza, fertilizes plots. The community mill is also a boon to farmers. They can now make their own maize meal instead of buying it, and the mill also produces pig feed from byproducts like maize cobs.



Colombian farmer Carlos Daza belongs to a local agricultural research committee in Cauca.

Better family nutrition, says Daza, is the most direct benefit of the CIAL's maize research. But the increased local capacity to organize, experiment, and share results, he says, can also be used on other crops.

As CIALs gain experience and the approach spreads, CIAT has been looking at the impact and examining a set of second-generation issues. A 1998 study, for example, revealed that CIALs produce beneficial spillover effects, over and above new technology, in the communities where they operate. A survey of 229 households in eight communities in Cauca found that independent experimentation by farmers who were not members of CIALs was higher in communities with CIALs than in those without. The groups seem to stimulate farmer experimentation in the wider community, which in turn diversifies production and gives farmers new options.

Apart from impact, a key issue for CIAT is the sustainability of CIALs. It is not just a matter of building financial autonomy. It also has to do with giving CIALs ongoing access to the technical and training support they need to respond to community priorities. In Cauca a group of more than 50 CIALs formed a support association called CORFOCIAL for this purpose. Operating funds come from interest earned on an endowment provided by a donor and invested in a Colombian financial institution. This is just one funding model that may prove useful in promoting the long-term viability of CIALs. As other Latin American farmer research committees mature, new support models will surely emerge.

CIAT scientists are systematically examining which factors and patterns of CIAL development lead to success. By feeding its findings into further work on participatory research, the Center continues working to empower poor farmers, presenting them with wider choices, new opportunities, and hope for a better life.

The ingredients of community land management

Farmer research committees are one of many tools for empowering rural communities in the fight against poverty and environmental degradation. Since 1992, CIAT has also been looking at various methods for helping poor communities manage natural resources in ways that allow farmers to make a decent living, while conserving the landscape that is their rightful heritage.

The first experimental site for this work was the watershed of the Cabuyal River in the hillsides of southwestern Colombia. Research there has since expanded to benchmark hillside sites in Honduras and Nicaragua. Funding has come from the Canadian, Swiss, and Danish governments, as well as the Inter-American Development Bank (IDB) and the Netherlands' Ecoregional Fund to Support Methodological Initiatives.

Simply put, a watershed is the geographical area drained by a defined network of rivers, streams, and springs. As one CIAT scientist has put it, a watershed provides "a common meeting ground for

A field visit with the CIAL "La Sabana" at Yorito, Yoro Department, Honduras.

communication, negotiation, planning, and impact monitoring for technical assistance." A watershed can be divided into subwatersheds and microwatersheds, depending on the desired scale of analysis and intervention. In laying out precise boundaries of a target area for research and community action, CIAT also takes into account the dynamics of the local economy, social conditions, and political jurisdictions.

Hillsides provide a logical focal point for CIAT research on community management of natural resources. They tend to be areas of entrenched poverty. Land holdings are generally small, making for a mosaic of farm plots owned by many individuals, often from different ethnic groups. Hillside areas may be environmentally vulnerable, especially because they are the locus of competition between forests and farming.

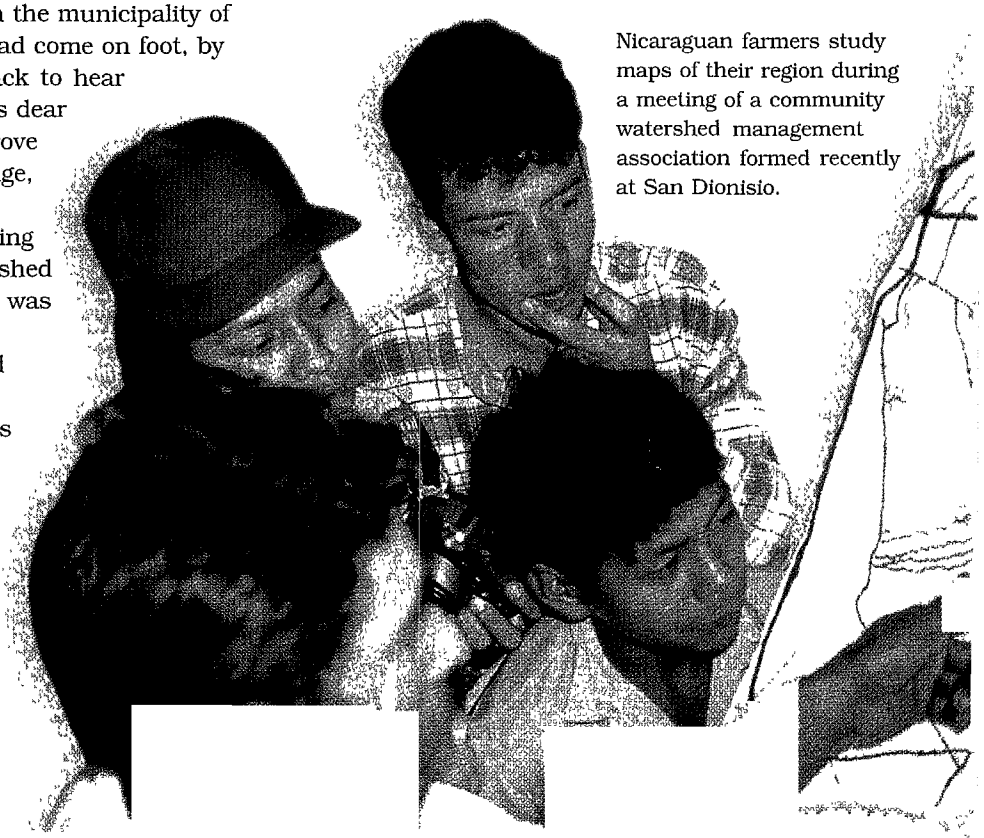
Equipping poor hillside farmers with environment-friendly production technologies is clearly important. But CIAT scientists realized early on that there was a much more difficult and fundamental people-centered job to be done: finding ways to organize and motivate communities to take charge of land management. Without solid structures in place to link the various players and stakeholders, solutions based only on improved technology are, at best, like temporary patches on a leaky roof.

Successful community management of resources requires the use of validated methods for uniting community members and local institutions in common tasks. It means getting them to speak a common language, to share a vision of what might be. The task may be to define and agree on needs and goals, set local priorities, target beneficiary groups (like poor women), map out an area's natural resources, or conduct research. It may be to raise funds for community projects, galvanize public support, or identify new market opportunities. Or it may involve rolling up sleeves and wielding shovels, hammers, and machetes—to dig wells, plant crops, install soil erosion barriers, or fence off a water source.

A village meeting in northwestern Nicaragua illustrates the organizational ingredient of community development at work. One day in March 1999, more than 50 people crammed into a classroom at a little blue-and-white school perched high on a mountainside in the municipality of San Dionisio. They had come on foot, by truck, or on horseback to hear and talk about things dear to them: how to improve daily life in their village, Susuli, and how to protect the surrounding landscape, the watershed of the Calico River. It was standing room only. Latecomers remained outdoors, crowding around open windows to listen to the proceedings.

Just 4 months earlier, Hurricane Mitch had hammered Central America, including this poor area of Nicaragua. Bean crops were wiped out and maize and coffee fields badly damaged by a week of solid rain. The course of the Calico River shifted and some people, especially cattle farmers close to the river, lost their homes and belongings. Mud slides swept away soil and vegetation from steep slopes.

The prospect of action to help Susuli get back on its feet was surely a powerful drawing card for this public meeting, organized by a fledgling association of community groups called *Campos Verdes* (Green Fields). But Campos Verdes, which CIAT helped launch early in 1998, is concerned with much more than emergency relief to farmers and other hurricane victims. It is an organization with a broad and long-term vision: better



Nicaraguan farmers study maps of their region during a meeting of a community watershed management association formed recently at San Dionisio.

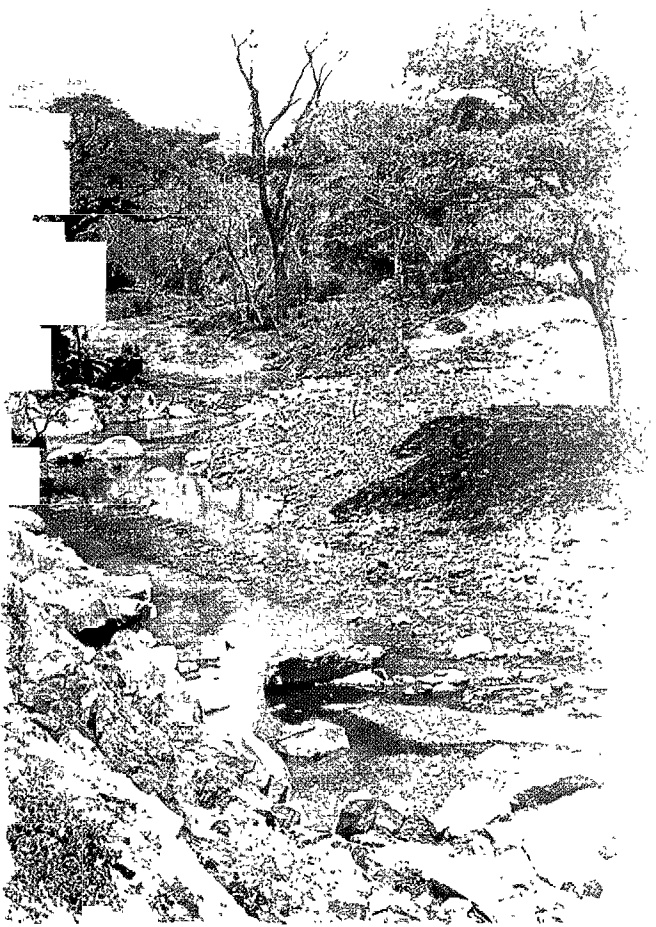
management of soil, water and trees, improved food security, dialog with local institutions and governments, and robust community organization and action in San Dionisio. The mix of interests it represents is as broad as its vision. Campos Verdes brings together local communities, water management committees, indigenous peoples, farmer-researcher committees, and other groups.

"It's much easier to get funding for infrastructure, health centers, and water projects when you're organized," says Campos Verdes president Mariano López. "One of our biggest problems is deforestation. The Calico River watershed has been depleted of trees. Reforestation and soil conservation are now critical."

The meeting's organizers, assisted by two CIAT staff, covered a lot of ground that day. Association secretary Juan Carlos Castro reported on a vegetable planting project involving 70 families from a neighboring village. Then he described the recent mapping of natural resources in various microwatersheds of the Calico River system—an area covering about 170 square kilometers. Seventeen communities were involved in the exercise, funded by Canada's International Development Research Centre (IDRC). He also presented plans for construction of a trail to improve local transport.

"How do we make a request for project support?" asked a member of the audience. An organizer explained the procedure for filling out request forms and presented a sample budget. "Does the person we elect to represent us in Campos Verdes have to be someone already on the water committee?" asked another. No, replied a member of the executive committee; community members may elect whoever they think best represents their interests.

A nomination was presented: Juan Molinarez. Heads turned and eyes focused on a man wearing a straw hat, standing near the back of the room. After brief discussion, the organizers called for a vote. The view of Molinarez was momentarily blocked by a roomful of raised hands. With the candidate confirmed, the meeting erupted in applause. Susuli now had its official representative to Campos Verdes; another link in the local organizational chain was in place.



Watersheds are a common ground for organizing collective action to combat poverty and natural resource degradation in hillsides.

CIALs are another key institutional link in the community management approach being promoted under CIAT's hillsides project. Since 1997 the Center has helped eight San Dionisio villages to set up farmer research committees. Beans, maize, soybean, and vegetables are the main topics of investigation. In 1998 an agreement was struck with Nicaragua's National Institute of Agricultural Technology (INTA) to provide scientific advice to the CIALs.

CIAT is now establishing a network of local experimental farms—called SOLs for "supermarkets" of options for hillsides—including one at San Dionisio. Based on demands expressed by the various groups that have a stake in watershed conditions, alternative technologies for improved agricultural production and resource management are being established on the farms and will be evaluated with the active participation of local farmers, including the CIALs. The SOLs will also provide sites for thesis research, training activities, field days, etc. In addition, scientists from CIAT and partner institutions will conduct strategic research at the farms to define the principles underlying successful options for extrapolation to other hillside sites.

Apart from the biophysical technologies being made available, CIAT has also worked with partners in several countries to develop nine decision-support tools for natural resource management and community action. For example, one guide explains a method for involving farmers in the design of simple, user-friendly indicators of soil quality. Another is a community-based method for measuring levels of human well-being and pinpointing pockets of rural poverty, as an aid to project targeting.

Under the hillsides project—whether in Nicaragua, Honduras or Colombia—cooperation extends far beyond the immediate confines of the target communities. In Nicaragua, for example, CIAT works with the geographic information systems (GIS) and remote sensing unit of the Ministry of Agriculture and Forestry. It recently provided technical training for GIS staff and is collaborating with them on a socioeconomic and biophysical atlas of Nicaragua, similar to the Honduran atlas mentioned earlier.

Another important national-level partner is the Faculty of Natural Resources and the Environment (FARENA) of the National Agricultural University. With CIAT support undergraduates are participating in studies of soil structure and fertility, water quality, and forest biodiversity in the Calico River watershed and two other FARENA sites.

CIAT, says José Ignacio Sanz, manager of the hillsides project, has an obligation "to bridge the gap between research and development, to ensure that we have concrete impact at the end of the day. So any assessment of our work shouldn't look only at whether our strategic research has come up with the intended products. It should also see whether those products have had an effect at the grass roots—both on the well-being of the people and the state of the natural environment."

Small farmers at San Dionisio have joined forces to establish their own community "supermarket" of options for hillsides.

CIAT

An International Workshop

Assessing the Impact of Agricultural Research on Poverty Alleviation

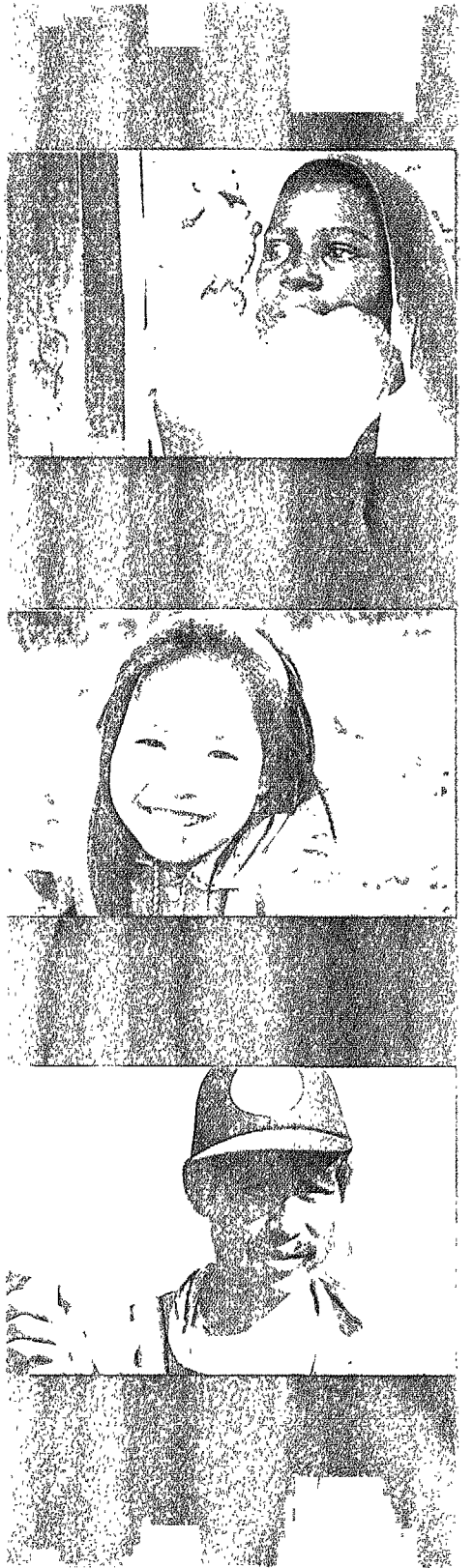
San José, Costa Rica, 14-16 September 1999

Informing Workshop Participants Through the World Wide Web

On 14-16 September 1999, a diverse and distinguished group of nearly 200 economists, scientists, and research leaders are gathering in San José, Costa Rica, to conduct a rigorous examination of the role research plays in alleviating poverty. In the months leading up to this workshop —which is being jointly hosted by CIAT, the Center for Research and Training in Tropical Agriculture (CATIE), and the Inter-American Institute for Cooperation in Agriculture (IICA)—we used our Web site to keep participants up to date on all aspects of the event. They were able to consult a workshop program with links to abstracts of all the presentations, refer to style guidelines for authors of papers, and check other helpful details.

In the following pages, we present further information available on our Web site that may be useful to readers of *CIAT in Perspective*. Any comments about this information will be most welcome.

http://www.ciat.cgiar.org



An Overview of CIAT

The CGIAR system

CIAT is one of 16 centers supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is a consortium of donor countries and organizations committed to sustainable agriculture in the developing world. The group is cosponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank.

CIAT's donors

CIAT currently receives funds through the CGIAR or under specific projects from the countries and organizations listed below. We gratefully acknowledge their commitment and contributions.

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- Australian Centre for International Agricultural Research (ACIAR)

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- General Administration for Cooperation in Development (AGCD)

Brazil
- Brazilian Agricultural Research Enterprise (Embrapa)

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- Canadian International Development Agency (CIDA)
- International Development Research Centre (IDRC)

Colombia
- Colombian Federation of Cattlemen (FEDEGAN)
- Colombian Institute for the Development of Science and Technology "Francisco José de Caldas" (COLCIENCIAS)
- Foundation for Agricultural Development (FUNDAGRO)
- Ministry of Agriculture and Rural Development
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Our mission

What To contribute to the alleviation of hunger and poverty

Where in tropical developing countries

How by applying science to the generation of technology that will lead to lasting increases in agricultural output while preserving the natural resource base.

Our project portfolio

CIAT's research is conducted through the projects listed below. These provide the elements for integrating research within the Center and for organizing cooperation with our partners. (Brief profiles of the projects are available upon request.)

Institutional links

Participatory Research Approaches
Partnerships for Agricultural Research and Development
The Impact of Agricultural Research

Crop improvement

Improved Beans for Africa and Latin America
Regional Bean Networks in Sub-Saharan Africa
Improved Cassava for the Developing World
Improved Rice for Latin America and the Caribbean
Multipurpose Tropical Grasses and Legumes

Agrobiodiversity

Conserving Plant Genetic Resources of the Neotropics
Using Agrobiodiversity Through Biotechnology

Pests and diseases

Integrated Pest and Disease Management

Soils and systems

Overcoming Soil Degradation
Sustainable Systems for Smallholders
Rural Agroenterprise Development

Land management

Community Management of Hillside Resources
Land Use in Latin America

Crop and agroecosystem focus

Within the CGIAR, CIAT has a mandate to conduct international research on four commodities that are vital for the poor: beans, cassava, tropical forages, and rice. Our work on the first three has a global reach, while that on rice targets Latin America and the Caribbean region.

Increasingly, the Center also helps national programs and farmer groups find solutions to production problems encountered with other crops by applying strategic research capacities developed through work on the mandate commodities.

In Latin America our research on natural resource management is organized largely on the basis of three fragile agroecosystems: hillsides, forest margins, and savannas. CIAT scientists also address key resource issues in our crop and production systems research for Africa and Asia.

Institutional links

CIAT is part of an emerging global system of agricultural research and development, whose strength depends, not just on the excellence of individual members, but also on the energy they invest in joint endeavors. For that reason we work hard to build ties with other institutions through research partnerships based on projects.

Our expanding circle of partners includes other international centers, national research institutes, universities, nongovernment organizations, and the private sector. We work with them under a variety of innovative arrangements, such as consortia and networks, at the local, regional, and global levels. Through strategic alliances with advanced institutes, we bring valuable scientific expertise to bear on the central challenges of tropical agriculture.

As a service to its partners, the Center provides varied offerings in training and conferences and specialized services in information and documentation, communications, and information systems.

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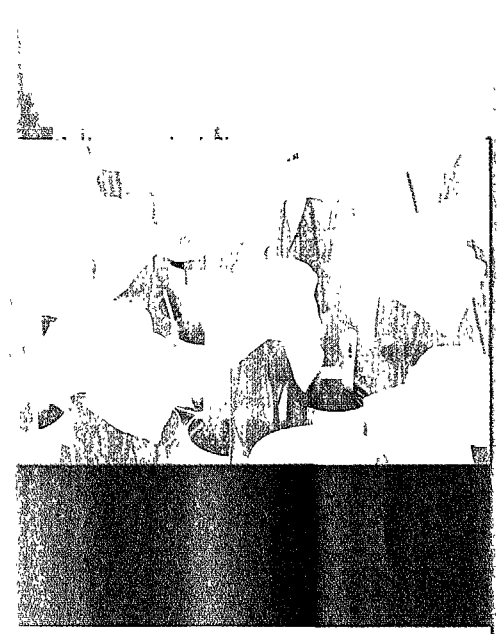

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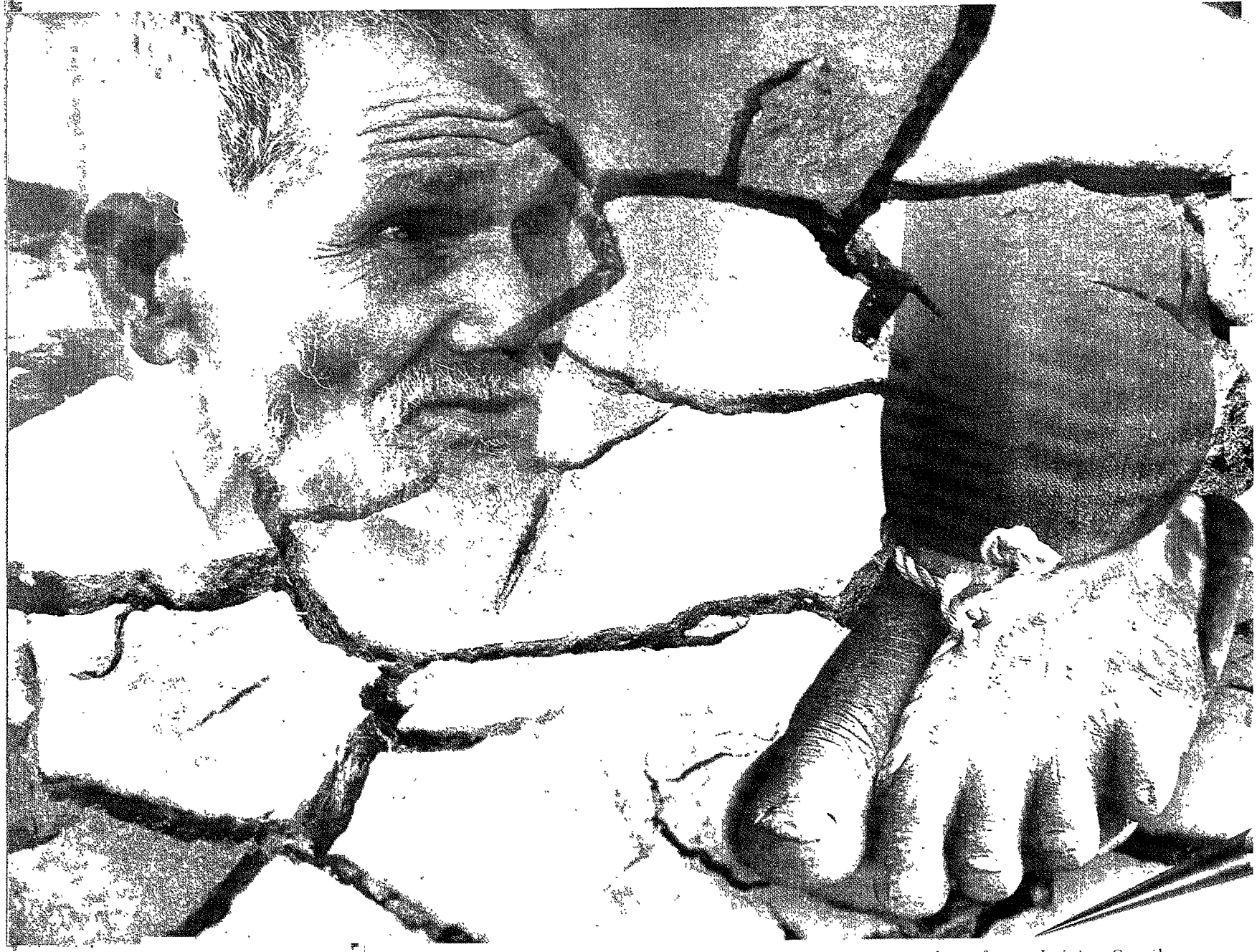

Honduran farmer Jerónimo González.

The Power of Perspective

Honduran farmer Jerónimo González has witnessed a lot of trouble in his 76 years, but he has never seen anything as bad as Hurricane Mitch. Last November it completely destroyed his bean crop on rented land near Danlí. "If we hadn't received this help," he says about Seeds of Hope for Central America (an emergency project mounted by four CGIAR centers and their local partners and funded by the US and Canadian governments), "we'd be even poorer now than we were before."

The improved bean seed that Don Jerónimo and thousands of other Central Americans received in the spring of 1999 was delivered by relief organizations but produced by small farmers with support from the Seeds of Hope project. Some of these same farmers also work with local research committees and watershed management associations, which are serving as engines of innovation for better crop and land management.

Even Mitch's fury could not long deter these tenacious women and men from seeking pathways out of poverty.

"This seed projec motivated us to continue working to improve our livelihoods. It also gave us a chance to offer our community the help it needed so badly."

Reina Janeth Hernández
Member of a women farmers' associa'ion Honduras