Sustainable Rural Livelihoods

CIAT's Strategic Plan 2001-2010

A Summary

CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

CIAT, Future Harvest, and the CGIAR

The International Center for Tropical Agriculture (CIAT) is a not-for-profit organization that conducts socially and environmentally progressive research aimed at reducing hunger and poverty and preserving natural resources in developing countries. CIAT is one of 16 food and environmental research centers working toward these goals around the world in partnership with farmers, scientists, and policy makers. Known as the Future Harvest centers, they are funded mainly by the 58 countries, private foundations, and international organizations that make up the Consultative Group on International Agricultural Research (CGIAR).

In 1998 the centers supported by the CGIAR created Future Harvest, a charitable and educational organization that catalyzes action for a world with less poverty, a healthier human family, well-nourished children, and a better environment and advances the debate on how best to achieve these ends.

Future Harvest reaches out to media, scholars, and scientists in the world's premier peace, environment, health, population, and development research organizations as well as policy makers and civil society, and it enlists world-renowned leaders to speak on its behalf. Future Harvest supports research, promotes partnerships, and sponsors on-the-ground projects that bring the results of research to farmers in Africa, Asia, and Latin America. For more information on Future Harvest, go to www.futureharvest.org.

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Enduring Mission, Changing World

About 1.2 billion people, one-fifth of the world's population, are "absolutely poor," each living on less than one US dollar a day. For two-thirds of these disadvantaged people, mostly women and children, poverty also means hunger, leading to malnutrition and declining health. The plight of the poor is made worse by environmental damage, including the massive destruction of ecosystems, loss of biodiversity, chemical pollution, soil and water degradation, and global warming.

While economic and technological progress in the past century has actually cut the proportion of the world's people who are poor, the "absolute" number of the poor remains staggeringly high. Persistent poverty, together with widespread environmental degradation, are two of the most pressing problems facing humanity at the outset of the 21st century.

CIAT's strategic plan for 2001-2010 takes stock of emerging trends, explores the potential for exploiting recent scientific advances, and envisions a future of sustainable rural livelihoods.

For more than 30 years, CIAT has successfully pursued its mission to reduce hunger and poverty in the tropics through scientific research leading to new technology and knowledge. Our results are used by farmers and other rural people to boost agricultural productivity and overall food production and to better manage the natural resources that support production.

The rationale for CIAT's task, still valid and compelling in 2001, is simple: Most of the tropical world's poor people live in rural areas where the daily struggle for survival depends largely, for the time being at least, on productive farming and wise stewardship of the land. This reasoning also extends to the fight against urban poverty. Efficient, sustainable production of crops and animals in the countryside keeps food prices low in city and town markets. This benefits poor urban consumers, who typically spend a much larger part of their income on food than do people in industrial countries.

The moral imperative to fight poverty and environmental destruction in the tropics through better agriculture and natural resource management has been a common and constant preoccupation of development agencies for many years. Yet, the global context in which solutions must be planned and applied to local or regional realities is rapidly changing.

At this critical juncture, CIAT's strategic plan for 2001-2010 takes stock of emerging trends, explores the potential for exploiting recent scientific advances, and envisions a future of sustainable rural livelihoods. In support of this vision, the plan outlines new directions and organizational arrangements for research, including the partnerships needed and the global and regional dimensions of future work.

Globalization

Globalization presents both opportunities and challenges to CIAT, its clients, and partners. On the one hand, advances in communications, information, and transportation have made the lives of the world's people more interconnected than ever before—politically, socially, and economically.

Trade barriers are falling, making for freer movement of goods, services, and capital across borders. These changes are accompanied by the rise of institutions with global reach, among them large nongovernment organizations, multinational corporations, global environmental conventions, and international scientific networks, like the centers supported by the CGIAR. Such trends offer the promise of greater scientific collaboration, joint efforts to solve global problems, fast technology diffusion, and new market opportunities.

On the other hand, globalization presents the risk of disadvantaged people being further marginalized. The poor of low-income countries are particularly vulnerable. They lack the power to adapt to and exploit global integration—be it political power, information power, market power, or the organizational power to change their circumstances. Without compensatory mechanisms, the tropical world's poor risk having the open door of expanding international opportunity slammed in their faces.

In the coming decades, most poor people will be concentrated in tropical rural areas of Africa and Asia, although parts of South and Central America continue to suffer from chronic poverty. While the fight against poverty and hunger in these areas demands greater food production and food security, that task is complicated by continuing population growth and expanding food demand. At the same time, recent evidence suggests that the pace of advances in agricultural productivity is slowing. Thus, a major threat looms: the prospect of a gap between food availability and people's needs.

Even if overall global food supplies remain adequate, international trade cannot be counted on to distribute food through market channels to people who lack purchasing power. This applies particularly to remote rural communities, where transport costs are high. Millions of rural families need higher incomes to guarantee their long-term food security. Agricultural livelihoods will continue to be the major source of that income.

Human and ecological health

Agriculture is widely recognized as damaging to the environment. It has reduced biodiversity, depleted soil and water resources, and caused contamination and health problems through widespread and often excessive use of agrochemicals. It is also a major contributor of two major greenhouse gasses, methane and nitrous oxide. Although environmental degradation is a major problem in the tropics, poor farmers are not in fact its major cause. Their livelihoods, though, are disproportionately harmed by the cumulative effects, and the rural poor have fewer resources at their disposal to take corrective or adaptive action.

Global warming, for example, will likely cause potential crop yields in most tropical and subtropical regions to decline. And overall, climate change is expected to slow the growth in world food production, resulting in higher food prices and added pressure on poor people. Food security is expected to worsen in Africa especially, the region least able to cope with such a threat. A further concern is the increasing scarcity of water in the face of competing demands.

Human health figures prominently in the global agricultural equation. While people depend on farm-based food production for adequate nutrition, including mineral and vitamin micronutrients, unsound agricultural practices are widespread and often undermine human health. For example, excessive pesticide use, besides threatening the natural environment, can

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also damage human health, through direct contact in the field or pesticide residues in food.

A progressive force for change

In this evolving context, CIAT seeks to be a socially and environmentally progressive force for change, conducting research relevant to the current and emerging problems of the world's disadvantaged people. We also recognize that pressing problems like land degradation, global warming, poverty, and hunger are not amenable to simple solutions. The complexity of these issues surpasses the ability of any individual scientist or institution to solve.

Effective "solutions that cross frontiers" require a multidimensional, multipartner approach, extending beyond scientific research. To this end CIAT works, and will continue to work, through institutional alliances—with other international centers, public agricultural research organizations in tropical countries, advanced research institutes in industrial countries, private-sector research, and civil society groups such as nongovernment organizations with grassroots development expertise.

Improving the livelihoods of small farmers through high-quality science is an effective and direct way to address the needs of the tropical world's rural poor.

A Vision of Sustainable Rural Livelihoods

CIAT's strategic plan for 2001-2010 reaffirms the Center's basic commitment to alleviating hunger and poverty while protecting natural resources. We believe that improving the livelihoods of small farmers through high-quality science is an effective and direct way to address the needs of the tropical world's rural poor, while supplying cheaper food for the urban poor. The notion of sustainable rural livelihoods is at the core of CIAT's vision for the future.

The sustainable livelihoods pursued by disadvantaged rural people should lead to the specific outcomes they desire. These include greater food security, reduced vulnerability to outside threats, improved family health and education, higher incomes to buy what cannot be produced, and a stable and productive natural resource base. In short, sustainable livelihoods are those that allow people to continuously and systematically build their physical, economic, and social assets, thereby giving them more control over their lives.

CIAT recognizes, however, that science-driven agriculture is just one of the ingredients needed to achieve sustainable rural livelihoods. Higher crop yields, reduced soil erosion, and effective use of new pest control technologies, for example, are by themselves not enough. Nonfarm assets and solutions must also be nurtured. Moreover, the journey from starting point to final destination—from the lofty ideal of sustainable livelihoods to the practical outcome of accumulated assets for rural communities—can be a long one.

As a research center specializing in people-centered solutions for tropical agriculture, CIAT uses science to help people get to three intermediate destinations along their path. These interdependent "critical conditions" are competitive agriculture, agroecosystem health, and the social capital needed for collective rural innovation.

Competitive agriculture

For rural livelihoods to be truly sustainable, it is not enough for small farmers to produce only enough food for home consumption. They must also earn cash to pay for life's other necessities, like medicine and school supplies. Selling part of their harvest is a key livelihood strategy.

With rapid urbanization in many low-income tropical countries, domestic markets for agricultural products are growing. Farmers need to move beyond traditional rural markets to respond to demand from cities and towns. In this expanding economic arena, small producers are not alone. They are often up against large, well-capitalized agribusinesses. And with the emergence of freer international trade, both through regional trading blocks and globally through the World Trade Organization, the pressure of competition is increased.

Intensification, diversification, and higher value added are mutually reinforcing tactics to make small farmers more competitive. Intensification boosts the productivity of land, labor, and other limiting factors—for example, through higher yields, better on-farm nutrient cycling, and more effective pest control. It does not necessarily imply heavier reliance on off-farm inputs, like purchased agrochemicals, since proven management methods are available to exploit on-farm renewable resources more efficiently.

Diversification helps farmers manage risk. Options include cultivating different varieties of the same crop species, introducing higher value species to their existing mix of staple crops, and integrating livestock with crop production. Diversity is essential at different scales: from the level of the farm field (crops and animals), to household level (different productive activities), to the landscape level (diversity in land use).

Two key strategies for adding value to production, which are also forms of diversification, are to adopt genetically superior varieties and to process some or all of production after harvest. For example, small farmers can grow cassava with improved starch quality, process it through cooperatives, and then sell it profitably to large agroindustries. Or they might grow popping beans—a traditional Andean food—and then package them as prepared snack foods for urban markets.

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Agroecosystem health

Degradation of natural resources is a major enemy of small farmers. Threats to the agroecosystem come in many intertwined forms: soil erosion, compaction, nutrient depletion, and acidification, shrinking or contaminated water supplies, loss of vegetative cover, reduced biodiversity, global climate change, and greater susceptibility of crops to pests and diseases. Some problems are acute and highly visible, others chronic and more subtle. Resource degradation undermines farmers' ability to compete in the market and sometimes has detrimental effects off-farm, especially in downstream communities. A healthy agroecosystem, like economic competitiveness, is essential to the sustainability of rural livelihoods.

Healthy ecosystems tend to be diverse, marked by a wide range of land uses and a high level of biodiversity. Knowledge of this diversity has proven valuable, for example, in efforts to reestablish seed production systems in

Africa after disasters. It is also essential to promoting synergies between human health and agroecosystem health.

Fragile environments, upon which so many poor farmers depend for a living, require special attention from research. If properly managed, natural resources in vulnerable settings, such as hillsides, can be quite productive and may be systematically improved. Evidence suggests the returns to research on the problems of such agroecosystems can be significant.

Rural innovation

Some aspects of ecosystem health and agricultural competitiveness cannot be managed by single producers acting on their own. Protection of soil, water, and forests, as well as pest control, often require collectively designed solutions applied beyond the scale of the single field or farm. By the same token, group action to acquire information on technology and markets goes a long way to ensuring that small farmers remain competitive.

The Center's core asset is a multidisciplinary team of researchers experienced in systems approaches to a range of biophysical and socioeconomic issues affecting agriculture and natural resource management.

Successful collective innovation by rural communities depends on the presence of social capital. This includes assets like competent leadership, community spirit and trust, experience gained through farmer participatory research, indigenous knowledge of the land, networks of people, and group access to external information. From the experience of working together, community members learn new skills and refine their judgment about what works and what does not. These new assets can then be harnessed for future community action, not only to improve agriculture, but to satisfy other needs, such as access to education, clean drinking water, and health services.

Easy access to external information sources, like the Internet, is still beyond the reach of most individual small farmers. However, shared services, such as community telecenters, offer new opportunities for social capital building and informed collective action on resource management, product marketing, and other community issues.

Science for Development

CIAT's experience and assets

CIAT's past contributions to rural development in tropical Latin America, Africa, and Asia have been significant and varied. They have emerged from research in areas such as genetic enhancement of crops and forages, pest and disease control, soil management, participatory research methods, and rural agroenterprise development. Today, the Center's core asset is a multidisciplinary team of researchers experienced in systems approaches to a range of biophysical and socioeconomic issues affecting agriculture and natural resource management. Supporting them is an extensive scientific knowledge base, a large germplasm collection, and an up-to-date infrastructure of laboratories and other research-support facilities. Just as important, we have long and rich experience working collaboratively with farmers and other agricultural specialists in a variety of local, national, regional, and international organizations. This mix of assets gives CIAT a special advantage in exploiting science for sustainable rural livelihoods in poor tropical countries.

Advances in science and technology

Genomics, agroecology, and informatics are three advancing areas of science and technology with enormous potential for addressing the interrelated problems of rural poverty, food insecurity, and environmental degradation. Molecular markers, for example, are now routinely used by CIAT and other research organizations to identify valuable plant genes, construct genetic linkage maps, and otherwise exploit the genetic diversity of important crop species, their close relatives, and wild ancestors. Increasingly, marker technology is also used to speed up selection and breeding of superior crop lines. These are plants that resist diseases and pests, yield well, have good nutritional content, and tolerate physical stresses.

Agroecological research is rapidly improving our understanding of complex links between plants, water, soil nutrients, and associated organisms, both harmful and beneficial. It presents new opportunities to make tropical farming more productive, economical, and environmentally friendly, as well as safer for farmers and consumers. For example, soil structure, fertility, and nutrient cycling can be improved through wise management of crop residues. And by manipulating the behavioral interactions between pest populations and their natural or introduced enemies, farmers can control pests effectively without resorting to excessive pesticide applications. Agroecology-based solutions not only improve the lot of poor rural producers. They also ensure a safer, more reliable supply of food to poor urban consumers and to expanding export markets in industrialized countries.

Advances in informatics, especially enhanced computing power and speed, underpin many recent scientific developments in agroecology and genomics. They also pave the way for farmers and rural communities to use information-intensive technologies. Of special significance are new opportunities for modeling complex systems, such as those involved in pest ecology, landscape dynamics, soil nutrient flows, and collective decision making.

Where processes are too complex for classic experiments, in which just one or a few variables are analyzed, improved modeling tools offer scientists a powerful alternative. But other stakeholders also stand to benefit as computer interfaces become more user-friendly and the costs of storing, analyzing, and communicating data drop. With this downstreaming of modeling tools, new opportunities arise for fuller community involvement in agroecosystem management. However, further research is needed both on the underlying modeling systems and on the social arrangements that will permit varied stakeholder groups to fully exploit these tools.

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CIAT's Core Competencies

To promote sustainable rural livelihoods, CIAT will integrate its wealth of past research experience with recent scientific advances such as those mentioned above. During the period covered by this plan, the Center will cultivate scientific competence in five core areas:

- Agrobiodiversity and genetics
- Ecology and management of pests and diseases
- Soil ecology and improvement
- Land management
- Socioeconomic analysis

This combination has distinct strengths. Each area of competence brings together related disciplines that have significant scope to contribute to and benefit from scientific advancement. And each can help CIAT and its partners to achieve a direct, positive, and lasting impact on rural livelihoods in the tropics. Furthermore, these core competencies are highly complementary, allowing for integrated approaches to problem solving. Together, they will form an enduring and stable institutional framework, at the same time giving CIAT the flexibility to respond to an evolving research agenda. As science advances and new research problems arise, adjustments will be needed. A major preoccupation of CIAT leadership will be to ensure that the human skills, technology, and equipment pertinent to these scientific areas are up to date.

Agrobiodiversity and genetics

Access to high-quality germplasm—for staple crops like cassava, beans, and rice, as well as alternative high-income crops—remains a high priority for small farmers. Genetic research, applied to conserved and characterized agrobiodiversity, leads to higher crop productivity, improved plant and soil health, and better human nutrition. Advances in molecular biology and ecology have markedly improved our understanding of agrobiodiversity in the centers of origin of crops. This has led to better strategies for conserving genetic diversity and improving crops.

Once the hitherto unexploited genetic diversity is introduced into domesticated crops, it will have an enormous impact on agriculture, including the livelihoods of poor farmers.

The application of molecular genetics and genetic transformation technologies is helping overcome basic obstacles encountered in traditional plant breeding, at the same time make breeding more efficient. New opportunities exist for unlocking the vast genetic diversity found in the wild ancestors and close relatives of cultivated crops. Plant breeders will be better able to address challenges posed by climate change and by physical stresses on food and fodder production, such as drought and high soil acidity. There is also considerable scope for genetically based improvements in crop yields, micronutrient content (for better human health), and resistance to pests and diseases. Once the hitherto unexploited genetic diversity is introduced into domesticated crops, it will have an enormous impact on agriculture, including the livelihoods of poor farmers.

Besides being key tools in crop improvement per se, genetic techniques and agrobiodiversity studies are also being targeted on insect pests, disease agents, and beneficial soil organisms. Work in this area has great potential for improving plant and soil health.

CIAT will continue to pursue a holistic approach to genetic improvement, taking into account both productivity and agroecosystem health concerns. Strong capacity in training and technology transfer will also be maintained. The Center will, however, place greater emphasis on developing germplasm that requires fewer agrochemical inputs and is better adapted to contrasting environmental conditions. Partnerships will be formed with other research institutes to develop strategic capacity in the areas of gene expression, gene function, gene cloning, and bioinformatics.

Public agricultural research programs have long been CIAT's key partners in germplasm development, conservation, and deployment. However, private research firms, seed companies, growers associations, advanced research organizations, and development NGOs now play a major role in this work. Increasingly, private organizations possess intellectual property, technology, and other assets, access to which is essential for public

R&D. In future, therefore, CIAT will work more closely with private and quasipublic institutions, as a complement to its still vital partnerships with public R&D agencies. In this context it will build, in collaboration with partners, its own intellectual property portfolio, making it widely available to bona fide users.

Ecology and management of pests and diseases

Crop damage by bacteria, fungi, viruses, insects, and other pests is a perennial risk in farming and can deal a knockout blow to rural livelihoods, especially if producers are poor, with little else to fall back on. In direct response to such threats, farmers all too frequently apply pesticides repeatedly and excessively. Unfortunately, this strategy can damage the environment, incomes, and health of farm families and other consumers. Pesticides are expensive and, ironically, often ineffective. In some cases their use may actually worsen pest problems. They can also contaminate water sources and food and kill nontarget organisms, resulting in loss of biodiversity. And as tropical farmers attempt to boost their incomes by growing high-value fruits and vegetables, they may find that inappropriate pest management tactics deny them access to lucrative international markets.

Safer, more effective alternatives to pest control, based on better understanding of agroecologies, usually combine several elements. These include the use of crop varieties with genetically based resistance to pests and pathogens; biological control (fighting pests with their natural enemies); and better farm management practices. Judicious use of agrochemicals may also be involved.

The genetics of plants and pests are now better understood at the molecular level. This knowledge is crucial to developing crops with stable resistance. Likewise, analysis of the behavioral interactions between pests and their natural or introduced enemies allows for more effective biological control. While new habitat, crop, and soil management strategies also contribute to pest and disease management, their effective use can only be based on detailed understanding of the social and economic conditions influencing farmer decision making and practices.

Soil ecology and improvement

Healthy, fertile soil is vital to overall agroecosystem health, agricultural productivity, and competitiveness. It therefore bears strongly on the sustainability of rural livelihoods. In poor tropical countries, the concern is not merely to avoid soil problems like erosion, compaction, and nutrient depletion, but also to enhance the quality of the resource, especially where degradation is already a problem.

The value of soil, of course, extends well beyond the farm. It is also a public "ecological service": a regulator of water quality and supply, a way to break down contaminants through microbial action, and even a carbon sink to slow greenhouse warming. How tropical farmers manage soil is relevant not only to *their* livelihoods but also to the survival of *all* terrestrial life. The fair and coordinated use of soils by different stakeholders, at different physical scales from local to global, requires multidisciplinary analysis of the tradeoffs involved. The idea of managing soils with these often-competing interests in mind is relatively new; in the past the approach was more fragmented and monodisciplinary.

How tropical farmers manage soil is relevant not only to their *livelihoods but also to the survival of* all *terrestrial life.*

Today, soil is viewed holistically, as a complex living system. Emphasis is put on managing fertility based on better understanding of factors such as nutrient flows through plants and soil organisms. Applying green manures (plants which, when cut and left to compost, build up soil organic matter) is one of many practical ways to improve soil structure and fertility. But for small farmers to fully exploit such methods, they need easy-to-use decision support tools and locally valid indicators of soil quality.

Many plant pests and diseases are soil-borne. So, their behavior is strongly influenced by soil conditions. Similarly, soil nutrient factors directly affect plant nutrition. Soil management and soil research, therefore, cannot be separated from pest and disease management and genetics research. They must be integrated, with soil biology playing a central role. Solutions to plant and soil health problems will involve a mix of strategies: genetic improvement, application of ecological principles, and carefully targeted use of control measures, such as natural enemies, biopesticides, and selected chemicals.

Rapid advances in GIS and modeling techniques, combined with participatory data collection and analysis, offer major opportunities for better land management.

One underexplored aspect of soils is their immense biodiversity and the role of constituent organisms in agroecosystem processes. Fortunately, molecular techniques and the ability to isolate genetic material from soils have opened up new frontiers for CIAT and its partners. Understanding soil carbon cycles and their relation to climate change is another important issue.

CIAT places strong emphasis on soils research and improvement as part of an overall agroecological strategy for conserving and enhancing natural resources, especially in areas at high risk of degradation. Research methods will be designed to ensure strong farmer participation, stimulate collective action, and take advantage of local knowledge. Strong interaction with the social sciences will help cultivate a multistakeholder perspective.

Analysis of spatial information

A key goal of CIAT's work with spatial information is to enable farmers to produce more food and fodder with less land and fewer risks to the environment. This recognizes that competitive agriculture and environmentally sound stewardship of natural resources should and can be complementary. However, land use decision makers, whether local farm communities or national government agencies, need appropriate data and tools to analyze trade-offs at the geographical scales that concern them. In practice, this means being able to estimate costs and benefits of various land-use options, including nonagricultural uses, such as tourism and conservation. The ability to identify and resolve potential conflicts between land uses at various scales is also important.

At the farm-field level, crop models can predict the impact of adopting improved germplasm or new cropping methods. Parallel decision-support tools can help with analysis of the overall farming system—everything from employment and income, to land productivity and the quality of natural resources. Geographic information systems (GIS) allow farm-level behavior to be modeled at the watershed level, so that the effects of scaling up can be predicted for factors such as resource degradation or improvement. They also allow for fuller consideration of issues like investment in infrastructure, accessibility to markets and services, and off-site effects of prospective or actual land uses. Land-use planners can simulate the impacts of

innovations, using models, or monitor actual effects, using a combination of field measurements, surveys, and satellite images.

Rapid advances in GIS and modeling techniques, combined with participatory data collection and analysis, offer major opportunities for better land management. However, more user-friendly interfaces need to be designed and relevant databases developed. In addition, national professionals need training in the use of decision-support tools. In this regard CIAT will continue to set up the necessary partnerships—with national agricultural research organizations, related ministries, NGOs, and international R&D agencies.

Socioeconomic analysis

Understanding how individual farmers and communities make decisions is crucial to the success of new technologies for improving rural livelihoods. Socioeconomic analysis is the core competency that supplies CIAT scientists with insights and empirically validated principles for designing people-centered solutions and evaluating their impact. It relies heavily but not exclusively on participatory methods.

Our social scientists will continue to provide valuable research products such as models, databases, and policy recommendations. But they will also add to their already substantial portfolio of manuals, guidelines, and training materials for use by partners such as community groups and local development organizations.

To manage their natural resources sustainably, individuals or families must sometimes sacrifice their personal, often short-term interests for the sake of longer term group aims. Social scientists can usefully analyze individual and group incentives for adopting or rejecting a particular innovation, as well as the possible outcomes.

Often, it is difficult for decision makers to anticipate the outcomes of their decisions about natural resources, like soils and biodiversity. Moreover, decisions made by one group may have unexpected consequences for another. Modeling research can better enable individuals or groups to foresee the effects of their decisions and actions.

Finally, a key contribution of the socioeconomics core competency will be to monitor and evaluate CIAT research outputs and assess their impact. The focus of assessment will shift away from production and income issues to those of improved sustainability and poverty reduction. New conceptual and empirical models are needed to assess the impact of CIAT outputs (such as management and organizational practices, information, and decision support tools) as well as to examine emerging issues, such as intellectual property rights.

The focus of impact assessment will shift away from production and income issues to those of improved sustainability and poverty reduction.

Setting CIAT's Research Agenda

The strategic plan sets out a broad vision for the future that will be implemented through medium-term plans, covering 3-year periods. These will specify detailed research objectives, resource allocations, and organizational mechanisms. The research agenda will require updating from one medium-term plan to the next in response to emerging trends, problems, and opportunities in tropical countries. The following policies and principles will guide agenda setting and implementation of this plan:

- Research priorities will be harmonized with partner groups that have first-hand knowledge of the constraints on sustainable rural livelihoods. To this end CIAT will, in its regions of focus, develop a joint research agenda with national research programs, farmer associations, and community development organizations.

- Center scientists will maintain regular contact with advanced research institutes to identify new tools, methods, and other scientific advances relevant to the implementation of the Center's strategic plan.

- Emerging problems and opportunities identified by CIAT and its partners as candidates for research will be evaluated against their relevance to the Center's mission. CIAT will look at the likely contribution of research aimed at improving agricultural competitiveness, agroecosystem health, and rural social capital. Proposed activities that meet the relevance criterion will then be assessed in light of CIAT's capacity to undertake the research. When activities fall outside CIAT's core scientific competencies, the Center will seek partner organizations with the suitable expertise. The Center will strive to find its unique niche and avoid counterproductive duplication or competition with other organizations.

- Availability of resources will necessarily figure in the implementation of this strategic plan. Stakeholders' commitment to invest in research, either through the global CGIAR effort or through contract funding, will be considered a key indicator of the feasibility of the proposed work. The willingness of national programs or advanced research institutes to contribute funds and participate in activities will likewise be an important consideration.

Key areas of CIAT's work have a global reach. They contribute to sustainable rural livelihoods in all three target regions of the world

Global and Regional Strategies

CIAT's research program fits into a global context, namely the work of the CGIAR centers. Some CIAT outputs, such as conserved agrobiodiversity, are essentially global public goods. Work in this and other areas, however, will continue to be harmonized with regional research agendas.

Special emphasis will be placed on the needs of hillside agroecosystems in Latin America and the Caribbean, the region in which CIAT has its headquarters. The hillsides of Central America and the Andes are a locus of poverty and are highly susceptible to natural resource degradation. Research on these agroecosystems therefore fits well with CIAT and CGIAR objectives.

Specific CIAT strategies will also apply to agroecosystems in the uplands of Asia and the highlands and midelevation areas of central, eastern, and southern Africa, areas with large numbers of poor people. These agroecosystems have many crops and natural resource problems in common with Latin American hillsides. CIAT will work closely with its partners in all three regions to define research activities with both global and regional dimensions. The hillsides focus builds on the orientation of CIAT's previous strategic plan.

Key areas of CIAT's work have a global reach. They contribute to sustainable rural livelihoods in all three target regions of the world, even though research may be conducted in specific sites. Among these research topics are beans, cassava, and tropical forages, including genetic

conservation and enhancement of these three crops, as well as participatory research methods, agroenterprise development, and management of natural resources.

Organizing for Impact

The 10-year plan outlined above rests on three guiding organizational principles: integrating global and regional research strategies; cultivating a mutually reinforcing set of core scientific competencies within CIAT; and mobilizing project-based multidisciplinary teams to solve problems and exploit opportunities.

Regional coordinators in CIAT's target regions will serve as focal points for dialog with national research programs. They will harmonize research agendas, promote strategic alliances, and mobilize resources. Equally important, they will ensure that research outputs mesh with regional development efforts, so that CIAT's strategic vision of sustainable rural likelihoods is realized.

The embodiment of CIAT's core competencies is a set of scientific communities within the institution, in regular and open communication with each other. They are charged with conducting research in multidisciplinary teams, ensuring scientific quality and the use of up-to-date methods, and advising on the best mix of scientific expertise. They will also manage key resources, like the biotechnology laboratory, genetic resources unit, soils and plant nutrition unit, and GIS facility. Project teams will have responsibility for detailed planning of research projects, following standard CGIAR procedures.

In view of falling levels of traditional official development assistance (ODA) to agricultural research, CIAT will make special efforts to secure support from alternative sources. These include tropical countries that stand to benefit from its research, philanthropic organizations, social marketing arrangements with the private sector, and as yet untapped sources within otherwise traditional ODA programs. Responsibility for resource mobilization will be shared among various groups within CIAT, including project teams, regional coordinators, and the senior management team. In support of their efforts, activities and investments in public awareness and resource mobilization services will figure importantly.

To link research to development, CIAT will actively market its scientific findings. All project teams will actively disseminate new products, such as technology and information, to potential users and investors. They will be supported in this effort by centralized training, publishing, and communications services.

The plan rests on three guiding organizational principles: integrating global and regional research; nurturing a mutually reinforcing set of core scientific competencies; and mobilizing project-based multidisciplinary teams.

Orientation of Future CIAT Research

Following is a summary of the objectives and orientations in key areas of CIAT's ongoing and future research as well as partnership arrangements.

Global reach

Beans (Africa and Latin America): development of highly productive climbing beans, drought-tolerant beans, and beans with higher iron content

for improved health, especially that of women; research through networks in Africa, Central America, and the Andes; collaboration with partners in Mexico and Brazil and with other Future Harvest centers.

Cassava (Africa, Asia, and Latin America): reduction in production costs, improvement in starch content, vitamin A content, and other traits; focus on small-farmer income generation through sales to starch and animal feed markets; development of biotechnology-based methods for cassava improvement, including genetic transformation; research collaboration through the Cassava Biotechnology Network and with the Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA), Brazilian and Asian national cassava programs, the International Potato Center (CIP), and the International Institute of Tropical Agriculture (IITA).

To link research to development, CIAT will actively market its scientific findings. All project teams will actively disseminate new products, such as technology and information, to potential users and investors.

Tropical forages (Africa, Asia, and Latin America): development of multipurpose grasses and legumes as animal feed, erosion barriers, soil covers, soil enhancers, and components in recuperation of degraded land; focus on hillsides in all three regions, with some attention given to savannas and forest margins; close collaboration with the CGIAR's Systemwide Livestock Program, convened by the International Livestock Research Institute (ILRI).

Participatory research (Africa, Asia, and Latin America): enhancement of social capital through development of widely applicable farmer participatory research methods for plant breeding and natural resource management; research carried out through the CGIAR's Participatory Research and Gender Analysis (PRGA) Program, coordinated by CIAT, with participation by numerous Future Harvest and other centers.

Agroenterprises (Africa, Asia, and Latin America): development of widely applicable methods and decision-making tools for designing and setting up environmentally sound small-scale rural enterprises such as crop processing; focus on enhancing market opportunities for poor rural people; emphasis on training trainers; research linkages with CIP in Asia and with IITA and the International Centre for Research in Agroforestry (ICRAF) in Africa.

Natural resource management (Africa, Asia, and Latin America):

- ***Soils***—development of soil management methods, soil quality indicators, and methods for monitoring their impact; selection of germplasm that uses natural resources efficiently and design of soil-enhancing strategies based on crop residues and green manures; research conducted through the CGIAR's Soil, Water, and Nutrient Management (SWNM) Program, with the collaboration, in Africa, of the Tropical Soil Biology and Fertility (TSBF) Programme.

- ***Whitefly***—research on whitefly as a direct plant pest and vector of plant viral diseases; focus on plant host genetic resistance and pest management options, especially for reduced use of pesticides; multipartner research conducted under the Global Whitefly Integrated Pest Management (IPM) Project, part of the CGIAR's Integrated Pest Management Program.

- ***Geographic information systems***—development of environmental sustainability indicators, decision support tools for landscape management, and tools for extrapolation to different spatial and temporal

scales; design of tools and methods for analyzing poverty and the agricultural effects of global climate change; research collaboration through the Consortium on Spatial Information, involving Future Harvest and other research centers, as well as national agencies in tropical countries.

Latin America and the Caribbean

In addition to the global research initiatives outlined above, CIAT will carry out research specific to this region on rice and tropical fruits as well as on agricultural and natural resource problems of the Amazon and savannas.

Key research objectives and partnership arrangements are as follows:

Rice: Emphasis on regional rice producers' competitiveness; strategic research to develop durable resistance to diseases, especially rice blast and rice hoja blanca virus; broadening the rice gene pool through crosses with wild relatives; collaboration with the Latin American Fund for Irrigated Rice (FLAR), the Colombian Ministry of Agriculture, France's Center for International Cooperation in Agricultural Research for Development (CIRAD), and the International Rice Research Institute (IRRI).

Tropical fruits: Emphasis on promoting high-value crop options for the region's farmers; strategic scientific support to national research on specific priority problems; use of CIAT's core competencies in genetics and agrobiodiversity that have already been developed for mandated crops; all research conducted through strategic partnerships but only where partner financing is available.

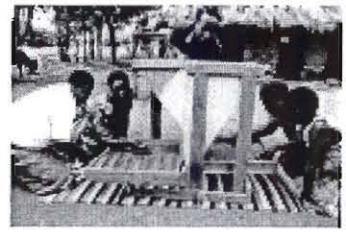
Amazon: Emphasis on socially and environmentally progressive land use systems that increase small farmers' incomes; conservation of threatened plant genetic resources; rehabilitation of degraded pastures and reduction of carbon emissions and economic losses due to poor fire management; research through partnerships with the Center for International Forestry Research (CIFOR), the International Plant Genetic Resources Institute (IPGRI), and ICRAF.

Savannas: Research emphasis on upland rice production, use of multipurpose forages, problems of soil acidification and fertility, and land use planning.

Central, Eastern, and Southern Africa

Rural communities in the highland and midelevation areas of this region are extremely poor and have inadequate agricultural services and infrastructure, such as marketing networks and roads. In the emerging global economy, these small farmers have minimal bargaining power.

Lessons learned by CIAT in other regions with similar agroecologies are often relevant to Africa and will be systematically adapted and applied there. Likewise, research done in collaboration with African partners can be fed into CIAT projects for extrapolation to Latin America and Asia. Strategic research by CIAT will be linked with research by regional and national partners in Africa. We will also strongly promote farmer participation in research, especially by women, who are the backbone of the region's agriculture. At the same time, CIAT will help build the institutional capacity of the region's



Lessons learned by CIAT in other regions with similar agroecologies are often relevant to Africa and will be systematically adapted and applied there.

national agricultural research systems, with the aim of promoting widespread use of research results.

Key research objectives and partnership arrangements for CIAT's work in Africa are as follows:

Crops and agroenterprises: Emphasis on enhancing bean, cassava, and multipurpose forage germplasm; development and adaptation of methods for rural agroenterprise development; partnerships with regionally managed bean research networks, IITA, cassava research networks, and national research programs.

Natural resource management/agroecosystem health: Emphasis on integrated nutrient management and integrated pest management; development of related decision support tools, including geographic information systems; partnerships with TSBF, SWNM, and the Global Whitefly IPM Project.

Asia

As in Africa, rural poverty is widespread in this region's upland areas of low agricultural potential, particularly among marginalized minority groups. A rapidly growing population is exerting heavy pressure on the ecosystem through intensified, often unsustainable, resource use. Water supply, in particular, is a strongly limiting factor in many areas. The challenge is to work with national programs to help farmers manage agricultural intensification.

Research in Asia will continue to be based on a systems approach for integrating improved cassava and forage germplasm with sound natural resource management methods.

Research will continue to be based on a systems approach for integrating improved cassava and forage germplasm with sound natural resource management methods. This will be complemented by CIAT expertise in nutrient cycling, participatory research, partnership formation, agroenterprise development, impact assessment, and the use of GIS in interpreting land use dynamics.

CIAT will maintain its strong research partnerships with crop and livestock R&D organizations in China, Indonesia, Lao PDR, Malaysia, Philippines, Thailand, and Vietnam. But it will also build new links with other national organizations. And to ensure complementarity with other Future Harvest centers, CIAT will continue to align its Asian research agenda with that of IRRI, CIFOR, and ILRI. We will also contribute to the Ecoregional Program for the Humid Tropics, led by IRRI.