

# Sustainable Rural Livelihoods

CIAT's Strategic Plan  
2001 - 2010



## **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](http://www.futureharvest.org).

**[www.ciat.cgiar.org](http://www.ciat.cgiar.org)**

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**FUTURE  
HARVEST**



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## Sustainable Rural Livelihoods

CIAT's Strategic Plan 2001 - 2010

**C**IAT is an international not-for-profit organization whose mission is:

*To reduce hunger and poverty in the tropics  
through collaborative research  
that improves agricultural productivity  
and natural resource management*

This mission is a commitment to overcome poverty and malnutrition in the low-income countries of the tropical world. It sees scientific research as a powerful instrument to generate knowledge and technology that can reduce poverty and malnutrition. It prioritizes agriculture as the means of sustenance of many of the world's poor, and confronts the reality that agriculture not only has a great impact on the environment but it is also critically dependent on improved natural resource management for its future capacity to feed a still rapidly growing population. It sees collaborative partnerships in research and development as central to any prospect of success in achieving its mission.

For over 30 years CIAT has pursued the essential elements of this mission, while periodically updating its vision and sharpening its strategy in light of new problems and opportunities. This *Strategic Plan* for 2001-2010 aims to position CIAT at the opening of the new decade.

The current globalization presents immense problems and opportunities. While huge strides are being made in science, billions of poor people in developing countries are at risk of being bypassed by these opportunities, and unprecedented threats to the environment are emerging.

To help solve the environmental and social problems faced by the world's disadvantaged people, CIAT seeks to be a progressive force for change in its overriding concern to make global science relevant to the poor.

CIAT foresees a forging of creative new partnerships for research and development with public and private sectors, advanced research organizations, and grass-roots organizations.

At this critical juncture, CIAT is appraising how it can best achieve its mission. This new *Strategic Plan* takes stock of current global challenges, explores the potential offered by scientific progress, envisions a future of sustainable rural livelihoods, and sets forth new directions for CIAT.

### Global Problems and Opportunities

#### Challenges of Globalization

**P**ersistent poverty and accelerating environmental degradation are two of today's most pressing global problems. The portion of the world's population that is poor has declined because of economic growth fueled largely by rapid scientific and technical advances. Even so, about 1.2 billion people today remain absolutely poor, with incomes of less than US\$1.00 a day. Among the



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worst consequences of this poverty is hunger, which affects more than 800 million people—mostly women and children—who must endure the resulting problems of malnutrition and weakened health. While these poor are being largely bypassed by technical and economic progress, this same economic growth and technical change is associated with growing signs of environmental damage that put all human health and welfare directly at risk.

Environmental degradation and absolute poverty are global problems with effects that reach far beyond the poor people themselves. Poverty, besides being ethically disturbing in an ever-richer world, exacerbates for everyone problems of health, peace, and security. Likewise, we are all threatened by environmental problems such as the mass destruction of natural ecosystems, loss of biodiversity, chemical pollution, degradation of soil and water resources, and accumulation of greenhouse gases.

Environmental degradation and persistent poverty are occurring in the context of massive global change. With advances in communications, transportation, and information technologies, people all over the world are both far more aware of their interconnectedness and far more integrated politically, socially, and economically. These changes are accompanied by the rise of new institutions with global reach, including, for example, global conventions on the environment, international nongovernmental organizations, multinational corporations, and international scientific efforts like the Future Harvest Centers for agricultural research. These social and technical changes promise greater scientific collaboration, increased coordinated international efforts to deal with global problems, wider and more rapid diffusion of new technologies, and new market opportunities.

Nevertheless, globalization puts disadvantaged groups at risk of further marginalization, with the low-income tropical countries being particularly vulnerable. The poor lack power, be it of information, the marketplace, politics, or even to change their own circumstances. Thus, even though globalization of science, information, markets, and collective action may promise a better world, without compensatory mechanisms, the poor in low-income tropical countries are at risk of being excluded from these opportunities.

## Poverty

During the coming decades, the largest numbers of poor people will be concentrated in low-income tropical countries, principally in Asia and Africa, but also in South and Central America where poverty is chronic. Globally, most poor people, especially the poorest of the poor, live in rural areas or are fleeing to seek better lives in the cities, where many live in urban squalor. Improving rural livelihoods is therefore the most direct way of addressing the needs of most of the world's poor.

Agriculture, including related postharvest activities, is by far the single most important source of income and employment for the rural poor. In addition, food is usually the largest expense of poor people. Thus, for most of the world's rural poor, agriculture and affordable food are key to improved livelihoods, even though other elements can sometimes be significant.

Moreover, overcoming food insecurity and hunger, which affect both the rural and urban poor, depends critically on agriculture. Food security cannot possibly be assured unless enough food is produced. However, hunger and poverty cannot be eliminated simply through additional food production alone. Even though global supplies may be adequate, international trade



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cannot be counted upon to distribute food through market mechanisms to poor people who lack purchasing power, especially in remote rural areas with high transport costs. Many of the rural poor need higher incomes to access food, and agriculture remains a crucial source of income for them.

Food production is also of great concern in that it must keep pace with continuing population growth. Producing enough food for future generations can be achieved only by increasing agricultural productivity. However, recent evidence suggests that the pace of increase in agricultural productivity may have begun to slow, raising the possibility of a gap emerging between future food availability and people's needs.

### Environment and natural resources

Even the sustainability of current agriculture is being questioned. Some scientists see today's agriculture as intrinsically damaging to the environment: it is notable for destroying biological diversity; for widespread and often excessive use of herbicides, pesticides, and fertilizers that severely damage the environment; for depleting water and soil resources; and for being a significant source of two major greenhouse gases—methane and nitrous oxide.

Environmental degradation induced by agricultural activities is a major problem in poor tropical countries. The highest rates of destruction of natural habitats occur as land is cleared for agriculture, particularly in Latin America and Africa, which have the greatest expansion of agricultural area. Land degradation is also a major problem, especially in Latin America, which has twice the area of severely or moderately degraded lands as has Africa and four times as Asia. Water is an increasingly scarce resource, facing competing demands from agriculture and urban uses. Poor farmers are not, in fact, the major cause of environmental degradation in the tropics, but their livelihoods are threatened by the degrading resource base.

### Climate change

A degrading environment has global consequences. For example, growing evidence confirms that temperatures are rising, which may lead to future reductions in potential crop yields in most tropical and subtropical regions. Currently, climatic change is expected to slow growth in world food production, thereby leading to higher food prices that the poor may have difficulty in paying. In particular, food security is expected to worsen in Africa. The ability of people to adapt to and cope with climatic change depends on such factors as wealth, technology, education, information, skills, infrastructure, and management capabilities. Developing countries, particularly the least developed countries, generally have less capacity to adapt and are thus more vulnerable to damage from climatic change. The poorest of the poor may often have the most to lose from climate change.

### Human health

Human health is directly related to agriculture. Obviously, human health is critically dependent on both nutritional quality, especially in terms of mineral and vitamin micronutrients, and quantity of food. Unsound agricultural practices can also negatively affect human health, for example, through excessive pesticide use, leading to the presence of residues in food. Agricultural practices can also indirectly affect human health by changing agroecosystems, which then change the behavior of disease vectors. Evidence from the Amazon, for example, indicates that clearing natural forest for



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agriculture has led to increased soil runoff that in turn has raised the level of mercury in fish thereby leading to harmful levels in human diets. Again, it is usually the poorest of the poor who are most vulnerable to health risks associated with inadequate diets or inappropriate agricultural practices.

### *Advances in Science and Technology*

Science can contribute significantly to resolving the interrelated problems of poverty, food insecurity, and environmental degradation, although, by no means, can any of these complex issues be fully resolved by a simple technical solution or other single measure.

Science and technical innovation can provide crucial elements to developing a new agriculture that is environmentally sound while also increasing agricultural productivity and reducing hunger among the poor people of the tropics.

Despite the difficulties of generating a new, more sustainable and productive agriculture for the tropics, much of which is characterized by fragile environments, several new scientific opportunities promise that such an agriculture can be developed. Advances in genetics, agroecology, and informatics can all contribute to the fulfillment of this promise.

#### Genomics

Rapid progress is being made in understanding and manipulating the genetic potential of biological organisms. While unlocking the human genome is no doubt the most newsworthy indicator of advances in genetic sciences, parallel leaps are also being made in agricultural genetics.

Genomes of crop plants are being mapped, revealing new insights into how plants grow and can be improved. Molecular markers for desirable genes are being identified for useful traits such as nutritional quality, disease and pest resistance, stress tolerance, and productivity. Use of such markers can rapidly speed the selection of new plants with improved traits. The functions of genes are becoming understood. New ways are being developed to combine, move, and control genes or their expression. These techniques offer great promise of enhancing the capacity to more fully use existing biodiversity in crop and forage species and their close relatives and wild ancestors.

#### Agroecology

A greater understanding of biodiversity and ecological principles will help improve the management of plant pests and diseases and ensure soil health through an agroecological approach that will enhance the biological processes of agriculture with less resort to interventions with agrochemicals. For example, pests can be more effectively controlled biologically by manipulating behavioral interactions between pest populations and their natural or introduced enemies.

Likewise, the biological management of soil fertility can result in a better flow of nutrients through plants and soil biota. Soil structure and fertility can be improved by managing crop residues, green manure, and soil biological activity. Such advances can help improve not only the situation of the rural poor, but also promote food security for the urban poor and reduce the negative ecological consequences of farming. Soil is a major carbon sink so



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that management practices of soils can either increase the emission of greenhouse gases or potentially sequester them.

### Informatics and complex systems analysis

The revolutionary progress in informatics and communication technologies not only underpins the scientific developments in agroecology and genomics, but also facilitates the intensive use of the resulting information and technologies by farmers and rural communities. Enhanced computational capacity, made possible by advances in computing technology, open up new possibilities for modeling and understanding complex systems, including bioinformatics, pest ecology, soil-nutrient flows, landscape analysis, and collective decision making.

This growing capacity to model complex systems can facilitate the understanding and management of these systems. Where processes are too complex to be satisfactorily reduced to classic controlled experiments that permit the observation of one variable at a time, improved modeling offers an alternative line for scientific research. While underlying models can become increasingly complex, simple user-friendly interfaces and reduced costs of storing, communicating, and manipulating data open up possibilities of more extensive use of these tools by increasing numbers of stakeholder groups. The availability of reliable data will be a key factor in exploiting the potential of these tools.

New approaches to decision-support models for multi-stakeholder participation in resource management by communities are emerging, which lead to the need for improved organizational frameworks to facilitate social action at the community level in such situations. Thus, opportunities for using complex models for "ordinary" decision processes are growing. To unleash this potential, scientific research is needed to develop the underlying modeling, ensure its relevance to stakeholder needs, and identify social arrangements that will permit the exploitation of these new opportunities.



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### Partners in Global Science

Pressing environmental problems like land degradation or global warming are no more subject to simple solutions than are socioeconomic problems like poverty or malnutrition. Adequately dealing with these problems requires a multidimensional approach, extending beyond research. As with scientific problems that require better understanding or new technologies, these problems also require both multidisciplinary approaches and a combination of strategic, applied, and adaptive research. The complexity of these problems, as both research and development issues, clearly surpasses the capacity of an individual scientist, or even an individual institution, to resolve. This is illustrated in commercial research in industries like informatics and health care, where strategic alliances among institutions with different comparative advantages are the norm.

CIAT fully recognizes that, in the case of the complex problems of agriculture, poverty, and environmental degradation in the tropics, the needed understanding and technology can be generated and transferred to users only through research and development partnerships. Moreover, a simple linear model of basic research to technology transfer, with different institutions assuming fully distinct roles, is clearly no longer appropriate. CIAT plays different roles in different partnerships and works through a wide variety of alliances. Below, we briefly describe some of the most important

partners in global agricultural research and development, and analyze some major factors affecting the different partners.

### National agricultural research systems

The national agricultural research systems (NARS) of tropical developing countries have long been CIAT's most important partners. Initially, these partnerships were based on a model of strategic research and national capacity building by CIAT. But today these partnerships are much more varied and sophisticated.

However, support for public agricultural science in low-income countries has weakened overall. For example, throughout much of Latin America, public research has declined as states have restructured. In Africa public science has always been limited because of highly constrained resources. Moreover, agricultural research is receiving less attention from overseas development assistance programs of the OECD countries and multinational agencies like the World Bank or the Inter-American Development Bank. Consequently, apart from a few large countries—Brazil, China, and India—public agricultural science in the tropics is not generally endowed with sufficient resources to be effective in meeting the needs of the poor, the food insecure, and the degrading environment.

### Private sector

In contrast to the NARS, the private sector's participation and investment in agricultural research has increased enormously in the last decade. Private research naturally focuses where commercial opportunities are greatest, and this has tended to be in temperate countries or in widely traded commodities. Nevertheless, the private sector is producing results that may offer important opportunities for dealing with poverty and the degrading environment in the tropics. The private sector now leads in many aspects of advanced genetic research, and many of these methods and results can be applied to tropical problems. Furthermore, under some conditions, the private sector can provide a highly efficient technology delivery that reaches even the small farmer.

Despite the private sector's greater resources, the opportunities that it offers do not extend to "orphan crops" that are not of commercial interest. Small-farmer crops, grown in fragile environments and less widely traded, are largely bypassed by the private sector. Moreover, private investment is restricted to research outputs that can be easily commercialized, including seeds and chemicals. Only the public sector will support research on, for example, agroecosystem management, which does not yield outputs for private sale.

Increasingly, research results are being legally protected as private property. Expanded property rights over scientific research results have attracted substantially greater private investment in agricultural research, especially in the temperate countries, for widely traded commodities. However, barriers to the free and open exchange of information and germplasm are being set up. Public research institutes face the challenge of balancing a commitment to open access of public goods, protecting public intellectual property from misappropriation, and working in partnerships where arrangements on sharing of benefits and property rights are clearly and equitably established.



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Growing controversies about the risks of transgenic crops, mostly released by the private sector, are threatening the profitability of some important lines of private agricultural research, leading to a significant market revaluation of agricultural research. If these issues persist, the viability of substantial private investment in agricultural research could decline. These matters, like some issues related to the distribution of benefits from research through different intellectual property right regimes, will be more fully resolved over the next decade, thereby clarifying the long-term role of the private sector in agricultural research.

### Civil society

Civil society, through a variety of nongovernmental organizations (NGOs), has a strong interest in the issues of poverty and the degrading environment. However, these organizations usually concentrate on policy advocacy, emergency relief, and community development rather than on research. Where opportunities exist, CIAT will proactively seek collaboration.

### Advanced research institutes

Universities and other public sector research institutes are another set of important partners in agricultural research. These institutions are particularly strong in advanced science and are often the source of new research methods that can be applied to the specific problems of tropical agriculture. Although many of the leading advanced research institutes are in the high income countries, many have strong links to tropical agriculture and share with CIAT a public service mission. Strengthening partnerships with advanced research institutes will be a high priority in the implementation of the *Strategic Plan*.

### Future Harvest centers of the CGIAR

Globally, the market clearly fails to supply scientific innovation for tropical agriculture, as is the case with tropical diseases. Both tropical agriculture and health issues are related to the particular characteristics of tropical biology, which presents a unique set of problems for which transferable solutions are not readily available from the high-income temperate countries. However, although specific to the tropics, most of these problems are not unique to a single country. Opportunities therefore exist for tropical countries to share public goods in solving their common problems.

The situation is compounded by the poor lacking market power to demand research innovations. Not only do they lack the economic resources to finance research, but they are not organized to effectively demand research. Failure to demand research is thus not solely caused by poverty. Research outputs can produce large external benefits that are not captured by the direct users of innovations. An inability to internalize these benefits is a further reason for the failure to supply innovations for tropical agriculture.

Delivering global public goods of technology and information to reduce hunger and poverty and improve natural resource management (NRM) in tropical agriculture is therefore the mission of CIAT and its companion Future Harvest Centers, which are all supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR system is currently undergoing change. This ongoing process is being guided by the following principles:



*Opportunities exist for tropical countries to share public goods in solving their common problems.*

- Focus given to reducing poverty and hunger
- Priority given to Africa and South Asia
- Use of modern science to tackle previously intractable problems
- Guidance by regionally determined priorities
- Working through partnerships to become “centers without walls”
- Adoption of a catalytic and organizing role, in addition to technology development
- Challenge programs: interinstitutional efforts focused on critical problems

While several of these “pillars” of the CGIAR have long been central to CIAT’s own strategy, the challenge programs represent an important new initiative. As seen below, the ongoing evolution of the CGIAR will have important implications for the development and delivery of global public goods.

## CIAT’s Vision for the Future

**S**ustainable rural livelihoods constitute the core of CIAT’s vision for the future. From this perspective, poverty is not seen merely in terms of income but also of human development. Overcoming poverty is not just surviving, but also achieving betterment; it entails obtaining, maintaining, and enhancing assets required for living. Poor people use their assets—human, social, natural, and financial—to pursue diversified strategies to achieve desired livelihood outcomes. Because livelihoods are peoples’ strategies and outcomes, people, particularly disadvantaged people, are the focus of CIAT’s vision. The livelihood outcomes desired by poor people—improved food security, better health, more income, reduced vulnerability, sustainable natural resources—become the ultimate driving forces behind the vision. Poor people, like others, strive for advancement in the desired outcomes. Livelihoods for the poor are not sustainable unless better outcomes are achieved over time and assets are enhanced.

This vision cannot be achieved by single measures: higher crop yields alone are not enough; reduced soil erosion alone is not enough; more effective transfer of new technology alone is not enough. Improved livelihoods for the poor come through the deployment of their diverse assets in different sectors, and for rural people, this means nonfarm as well as farm assets. Although improvements in agriculture alone cannot achieve sustainable livelihoods for the rural poor, as noted above, agriculture is central to the livelihoods of most of the world’s poor. Because most of the world’s poor are rural, CIAT’s niche in achieving sustainable rural livelihoods consists of helping the poor attain three critical conditions:

- Competitive agriculture
- Agroecosystem health
- Rural innovation through social capital

These three conditions are interrelated. Without healthy agroecosystems, competitive agriculture cannot be long sustained. Without strong rural innovation to enhance the capacity for collective action, natural resources cannot be managed to ensure agroecosystem sustainability. Without rural innovation through collective action by strong communities, lack of access to information and markets will severely impede agricultural competitiveness. Without a competitive agriculture, people cannot easily afford to care for natural resources. Without a competitive agriculture, rural communities will



*People, particularly disadvantaged people, are the focus of CIAT’s vision.*

lack a strong economic base and will be less able to make needed innovations.

### *Competitive Agriculture*

Competitive agriculture is crucial to sustaining rural livelihoods because agriculture is a major source of employment and income for rural people. Although nonfarm income is important for many rural poor, few instances exist where their livelihoods can be sustained at an acceptable level without competitive agriculture.

The sustainability of rural livelihoods depends not only on factors within the rural sector, but also, and fundamentally, on the nature of links with the domestic urban sector and of wider global connections. Urbanization is growing throughout the low-income tropical world, accompanied by growing markets. The wide variety of farm types, ranging from small family farms to large well-capitalized agroenterprises, all compete to supply the cities' growing demand for food. Thus, an efficient competitive agriculture contributes to the welfare of the urban poor through increased availability of food at a lower price.

Simultaneously, economic and political barriers to international trade are eroding, both within regional trading blocks such as NAFTA (North American Free Trade Agreement) and MERCOSUR (Mercado Común del Sur), and globally, through the WTO (World Trade Organization). This increasing globalization further intensifies the competitive pressures on tropical small farmers and other producers.

The competitiveness of agriculture also depends on the degree to which all costs are included. What may be an efficient competitive agricultural activity from an individual point of view may not be competitive if full social and environmental costs are taken into account.

Although on-farm food production remains important for many small farmers in the tropics today, essentially all rural poor people require a cash income to pay for clothes, medicines, school fees, and other necessities. Being able to compete in agricultural markets by selling part of their produce is key to earning this income. If rural people, including small farmers, cannot participate in the marketplace because their agriculture is not competitive, then their livelihoods are unsustainable in today's world. Without a competitive agriculture, rural resources of labor and land will neither find employment nor earn incomes to sustain livelihoods.

Intensification and diversification are two broad, mutually reinforcing strategies to attain agricultural competitiveness. Intensification increases agricultural productivity of limiting factors. This can be achieved, for example, through improved yields, better on-farm cycling of nutrients, more effective control of pests or planting higher value crops or adopting new postharvest processing techniques. Intensification can be promoted through improved use of on-farm resources or renewable resources like information, and does not necessarily depend on high use of off-farm inputs like agrochemicals.

Diversification is a major strategy for sustaining rural livelihoods and contributes an essential resilience to small-farmer systems. It is an important mechanism for risk management. Diversification includes introducing biodiversity in individual crop species; integrating crops and livestock; ensuring seasonality of activities and resource flows; and widening



*Intensification and diversification are two broad, mutually reinforcing strategies to attain agricultural competitiveness.*

the diversity of both food staples and high-value crops. Diversity is essential at different scales, including diversity of plants at the field level, diversity of activities at the household level, and diversity in land use at the landscape level. Diversification can be key to achieving intensification, and diversification into higher value crops or value-added processing is an important option.

Another important component of agricultural competitiveness is adding value to a farmer's produce, whether through postharvest processing or genetic improvement. Examples are cassava with improved starch quality, popping beans processed as a snack food, or crops with improved nutrient content. Competitiveness is improved by obtaining higher prices for improved qualities.

### *Agroecosystem Health*

Agroecosystem health is a second essential condition for achieving sustainable livelihoods for rural people. Unhealthy agroecosystems are characterized by degraded natural resources. While not always immediately apparent, over a longer period, the unsustainable use of natural resources undermines productivity and competitiveness. This is frequently on-farm, but resource degradation can have major costs off-site, both in the immediate rural environment and beyond. Agroecosystem health is also threatened by global processes like climate change.

Agroecosystem health is needed for high levels of productivity. Although external inputs like agrochemicals have contributed significantly to productivity, evidence increasingly suggests that excessive use of agrochemicals can be significantly detrimental to agroecosystem health. Healthy ecosystems are diverse in terms of, for example, biodiversity and land use. Understanding this diversity has proved valuable, for example, in supporting the recovery of African seed production systems after disasters. Important linkages may also exist between agroecosystem health and human health.

Special attention needs to be given to agroecosystem health in vulnerable or fragile environments. These agroecosystems may be highly productive but, through mismanagement, can be at risk of suffering substantial degradation. Many of the poor depend on fragile environments for their livelihoods, and their welfare would be seriously jeopardized by the degradation to which these environments are so susceptible. If properly managed, however, vulnerable environments can be made more productive. Farming in fragile environments is neither an intractable task nor a path toward poverty. Indeed, evidence suggests that the returns to research in such agroecosystems can, in fact, be high.

### *Rural Innovation and Social Capital*

Innovative collective action by rural communities with substantial social capital, that is, communities with an effective capacity to work together to solve common problems, is a third essential condition for sustainable rural livelihoods. Many aspects of agroecosystem health can be successfully managed only through collective action. This is clearly the case for common resources like water or forests. Likewise, problems of soil erosion or pest management often cannot be effectively managed at the level of the individual small farm.



*If properly managed, vulnerable environments can be made more productive. Farming in fragile environments is neither an intractable task nor a path toward poverty.*

Collective action can greatly enhance agricultural competitiveness. Even when small farmers are competitive in producing a crop, higher transaction costs in marketing often reduces their overall competitiveness. Collective community cooperation in obtaining information on markets and technology can do much to promote competitiveness among small farmers, thereby contributing to sustainable rural livelihoods.

Finally, effective community action removes some important dimensions of poverty besides low cash income. Many rural areas are poor not just because they lack cash but because they cannot meet basic needs, like access to education, clean drinking water, and health services. Community action to meet these needs is often critical to sustaining livelihoods in rural areas.

Community action can be enhanced to create social capital, an asset that can provide a variety of supportive mechanisms for enhancing rural livelihoods. Local or indigenous knowledge is a major resource in supporting community action. Farmers participating in agricultural research can help identify, adapt, and diffuse improved production technology to enhance competitiveness. Community action to identify market opportunities and organize cooperatively to access markets can be essential to developing and seizing new opportunities to improve competitiveness.

Community management both of pests and of natural resources such as soils, water, land, and biodiversity, can be critical for agroecosystem health. Information on market participation, resource management, and technology use can increasingly be obtained through new communications media that link, at relatively low costs, rural communities with the global information system. Access to such information is now commonplace among large well-capitalized farmers in high-income countries but in the rural tropics is lacking for individual farmers. However, obtaining access is eminently feasible at the community level, for example, through local telecenters.

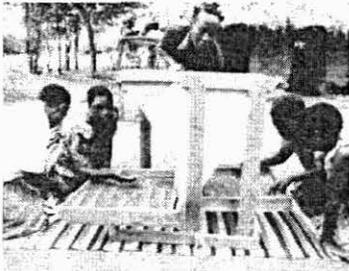
CIAT has a long track record of research in areas that contribute to the formation of social capital. This includes research on farmer participatory research methods, methods for establishing successful rural agroenterprises, and decision tools and organizational models for community watershed and resource management. CIAT will focus on strategic research on these issues, while implementation will be carried out by national partners in development projects.

## Science for Development

### CIAT's Core Competencies

**S**ustainable rural livelihoods comprise the core of CIAT's vision. To achieve them depends on three essential conditions: agricultural competitiveness, agroecosystem health, and rural innovation. Science is the critical instrument that CIAT will employ to help realize these essential conditions.

Science has the power to create new knowledge and technology that enable people to solve problems, discover new opportunities, and improve their welfare. In particular, as has been noted above, scientific advances in the fields of biotechnology, agroecology, and informatics for complex systems analysis all offer the prospect of new opportunities to overcome the persistent



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problems of environmental degradation and human poverty. Of course, science alone cannot attain sustainable rural livelihoods. But when accompanied by other important conditions—political, social, and economic—scientific knowledge and technology can contribute significantly to this vision for the future.

CIAT's scientific research over the last 30 years has contributed to sustainable rural livelihoods in Latin America, Africa, and Asia. These contributions have come from diverse fields, including genetic enhancement of crops and forages, new systems for pest control and soil management, and new approaches to participatory research, and rural agroenterprises to more effectively use the social capital of rural communities.

Through these efforts, CIAT has acquired a multidisciplinary staff composed of scientists who are experienced with the problems of tropical agriculture and natural resources, an up-to-date infrastructure of scientific laboratories and facilities for such research, and a rich experience in research collaboration with partners. These research partnerships enable CIAT scientists to work with an extensive worldwide scientific network, including national programs in developing countries, advanced research organizations (AROs) in high-income countries, and other international centers. These assets of scientists, infrastructure, a web of longstanding partnerships, and a culture of using a systems approach to multidisciplinary science all combine to give CIAT a special capacity to conduct scientific research to enhance sustainable rural livelihoods in poor tropical countries.

CIAT proposes to nourish five core scientific competencies as its long-term assets for working toward sustainable rural livelihoods. Each core competency is composed of a critical mass of scientists in related disciplines supported by appropriate infrastructure.

- Agrobiodiversity and genetics
- Ecology and management of pests and diseases
- Soil ecology and management
- Spatial Analysis
- Socioeconomic analysis

These core scientific competencies will be deployed to implement an evolving agenda that is always focused on reaching sustainable rural livelihoods. These core competencies function as scientific communities, bringing together scientists of specialized but interrelated skills. CIAT's set of core competencies needs to be selected both in terms of their potential impact on achieving sustainable rural livelihoods and CIAT's ability to deliver that impact. This depends on a variety of factors, including past experience, existing institutional and human capacities, and complementarity with partner organizations. To continue making cutting-edge scientific contributions, CIAT must choose core competencies that have significant scope for scientific advance. Furthermore, these core competencies should be interrelated and mutually reinforcing. They must be chosen for their complementarity and their effectiveness when deployed together in an integrated fashion toward the vision of achieving sustainable rural livelihoods in the low-income tropics. Figure 1 illustrates how these five competencies mutually interact to improve sustained rural livelihoods.

These core scientific competencies are among the most enduring and stable elements in the institution because, although specific problems are resolved over time, the capacity for problem solving, including new problems that may emerge, is embodied in the core competencies. As science



*CIAT's scientific research over the last 30 years has contributed to sustainable rural livelihoods in Latin America, Africa, and Asia.*

advances, the core competencies themselves must evolve. New skills will be needed, together with new scientific equipment. Keeping the human and physical capital of CIAT's core competencies up-to-date will be a major concern for research leadership at CIAT.

### *Agrobiodiversity and Genetics*

Genetic improvement and agrobiodiversity contribute directly to both agricultural competitiveness and agroecosystem health. Participatory work with small farmers consistently finds that the first innovation in agricultural production that most small farmers seek is improved germplasm of their staple crops. Their second priority is novel germplasm for new income-generating crops. Genetic improvement uses conserved and characterized agrobiodiversity to enhance human health, crop productivity, plant health, and soil health. Rapid scientific advances in both molecular biology and ecology have greatly increased the understanding of the complex agrobiodiversity found in crops' centers of origin, thereby leading to the design of more efficient strategies for conservation and genetic improvement, which are especially important components of agricultural competitiveness in the tropics.

Expanding knowledge of genes and genomes, using molecular genetics and in some cases transgenic technologies, can greatly improve the efficiency of breeding by overcoming previously intractable constraints to genetic diversity. Such technologies, integrated with on-going breeding activities, will help address the challenges posed by climatic change and other stresses such as drought, soil degradation, and soil acidity. Furthermore, these technologies create significant new opportunities for better conserving and exploiting the genetic diversity of cultivated germplasm, wild ancestors, and close relatives of domesticated crops to achieve several important plant improvement objectives. A lot of naturally occurring genetic diversity was bypassed during the domestication of wild plants into crops. This diversity, which has not been included in breeding efforts, will have huge impact, once introduced.



*Participatory work with small farmers consistently finds that the first innovation in agricultural production that most small farmers seek is improved germplasm of their staple crops.*

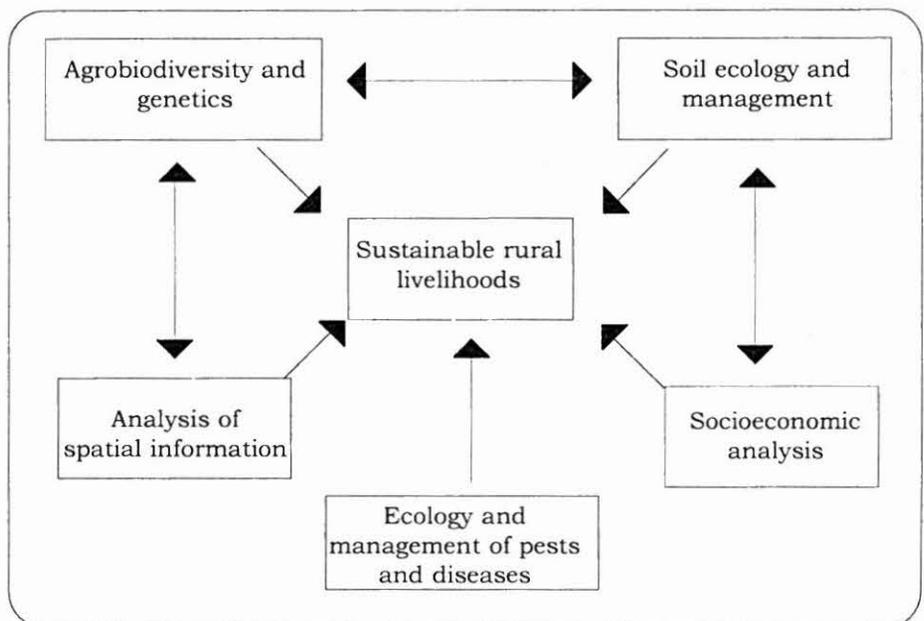


Figure 1. Core scientific competencies for attaining sustainable rural livelihoods in low-income tropical countries.

Considerable scope exists for genetic improvement in yield; added-value traits, including quality characteristics such as nutritional value; resistance to pests and diseases; and adaptation to environmental stresses. Participatory approaches will help identify key farmer criteria for genetic improvement. Besides being an important tool for crop improvement, agrobiodiversity studies of plant pests and pathogens and beneficial soil organisms will contribute significantly to improved plant and soil health. New approaches to geographic information systems (GIS) will help target improved germplasm to specific biophysical and socioeconomic environments.

Genetic improvement will continue being deployed with a set of management practices that take into account issues of productivity and agroecosystem health. Improved genetic material will be best used through management with an agroecological perspective, for example, to prevent breakdown in pest resistance and reduce pesticide use. Greater emphasis will be devoted to develop germplasm that requires less agrochemical input and is better adapted to contrasting environmental conditions. To accomplish these objectives, CIAT will establish the needed partnerships to develop strategic research capacity in areas related to gene expression, gene function, gene cloning, and bioinformatics, and their integration with crop and forage improvement. CIAT will also maintain its strong emphasis on training and technology transfer.

Partnerships have always been essential to CIAT's development, conservation, and deployment of improved germplasm. Public agricultural research institutes have long been the principal partners for this purpose. However, in tropical countries, the nongovernmental sector is now playing an increasing role in the development and distribution to farmers of improved crop varieties. These institutions include growers' associations, small-scale farmer or community enterprises, local and national seed businesses, and commercial seed companies

At the same time, private companies are playing a major and growing role in global agricultural research. They are obtaining growing control over genetic improvement methods and intermediate products. Future public capacity in the low-income tropical countries to contribute to genetic improvement will increasingly depend on access to these private assets. Partnerships with a variety of quasipublic and private institutions will become increasingly important if CIAT is to obtain access to privatized technologies, to ensure the freedom of delivering improved germplasm, and to complement longstanding partnerships with public agricultural research institutions. In this context, CIAT will pursue innovative initiatives to develop its own intellectual property portfolio in collaboration with partners, and will make this intellectual property available to ensure the achievement of its mission. CIAT will also work with its partners to address the increasingly complex issues of biosafety and intellectual property rights.

As noted above, the second priority of farmers is novel germplasm for new income-generating crops. Currently, poor farmers in the tropics have little idea of which novel crops could potentially be introduced into their farming systems, especially in the case of exotic crops whose center of origin is in other continents. Such crops are often potentially the most promising new alternatives. CIAT could play an important role in ensuring that local organizations can obtain information on germplasm of potential interest in their region of influence and also to assist them in making the necessary contacts to obtain that germplasm.



*CIAT will work with its partners to address the increasingly complex issues of biosafety and intellectual property rights.*

## *Ecology and Management of Pests and Diseases*

Biological pests—arthropods, bacteria, fungi, and viruses—cause immense losses in agricultural production and postharvest handling, thereby lowering productivity, reducing incomes of poor farmers, and undermining their agricultural competitiveness. Farmers' efforts to arrest the often highly visible damage wrought by pests increase production costs, particularly through the use of toxic pesticides that often not only fail to effectively reduce crop losses, but also lead to escalating and worsening pest damage. Moreover, inappropriate pesticide use is a major cause of human health problems for farmers, rural communities, and urban consumers. In addition, negative impact on the environment and biodiversity is the common consequence of inappropriate pest management. Finally, as farmers in tropical countries increasingly attempt to take advantage of the high-income opportunities in global markets for high-value fruits and vegetables, they are finding that ineffective pest control strategies can deny them access to these markets.

Ecologically sound disease-and-pest management can contribute directly to improved agricultural competitiveness, and agroecosystem and human health, while innovations in the social capital of community action are often required to achieve ecologically effective pest management. Communities of small farmers, especially, often find the effective reduction of pest populations on a single plot or farm difficult. Scientific advances offer promising alternatives to the classic pesticide-based control packages that have so often failed. These alternatives include host-plant resistance, biological control, and new management practices for habitats, crops, and soils.

A systems approach to pest management is an overriding challenge and requires an understanding of the interactions between host-plant and pest genetics to develop crops with stable resistance. Strategic deployment of crop genetic diversity will often be crucial, and can now be enhanced by better understanding both host-plant and pest genetics at the molecular level. Molecular characterization of pests can help interpret their epidemiology and ecology. Likewise, understanding the behavioral interactions between pest populations and their natural or introduced enemies can offer more effective strategies for the biological control of pests. Habitat, crop, and soil management practices can make significant contributions to pest and disease management, but improving these practices requires not only an understanding of the natural and biological systems involved, but also of the socioeconomic system in which farmers must make management decisions.

Rapid advances in several related areas, including molecular genetics, pathology, agricultural ecology, entomology, and virology, mean that a community of researchers in this core competency will have great opportunities to significantly contribute to agricultural competitiveness and agroecosystem health.

## *Soil Ecology and Management*

Soil is fundamental to agricultural competitiveness. Agricultural productivity depends critically on soil health and fertility. Unsustainable soil management practices that degrade soils by depleting nutrients, reducing soil biological activity and biodiversity, and causing soil erosion, compaction, and acidification all worsen agroecosystem health and productivity. Unsustainable soil management not only directly affects the farm, but also the entire watershed. Soil erosion has serious off-site consequences that affect other sectors such as urban water supply and hydroelectric energy



*Scientific advances offer promising alternatives to the classic pesticide-based control packages that have so often failed. These alternatives include host-plant resistance, biological control, and new management practices for habitats, crops, and soils.*

generation. Similarly, the heavy use of inorganic fertilizers has led to serious off-site environmental problems in industrialized countries. However, the major concern of poor tropical countries today is not just to avoid these environmental problems but also, and more urgently for rural livelihoods, to find ways of maintaining and increasing soil fertility and thus improving crop productivity and agricultural competitiveness.

Society places additional value on soil for the ecological services that it provides in watershed systems such as regulation of water supplies and quality, and bioremediation of contaminants. There is increasing concern over the soil's ability to cope with rapid changes in land use (resilience) and increased interest in the soil's role as a carbon sink in mitigating global climatic changes. Inevitably, trade-offs must be considered when soils are used by different stakeholders at the watershed scale, thus requiring multidisciplinary approaches. The concept of managing soils with these trade-offs in mind is relatively new because of the previously fragmented disciplinary approach taken to soil management.

Soil is viewed today as a living system that integrates biology, chemistry, and physics. Emphasis is given to the biological management of soil fertility through a better understanding of, for example, the flow of nutrients through plants and soil biota. Soil structure and fertility can be improved through the management of crop residues, green manure, and soil biological activity. Because farmers manage soils and crops, their decisions are clearly crucial to soil health. Thus, decision-support systems and soil and water quality indicators for use by farmers are essential for resource conservation and productivity enhancement.

As well as being an important dimension of agroecosystem health, soil health is critical to crop productivity and thus to agricultural competitiveness. Soil as the source of plant nutrients is a major and critical determinant of crop productivity. Nutrient-deficient plants are more prone to pathogens and pests. Moreover, many serious plant pests and pathogens are soilborne, and their behavior is also affected by soil conditions. Soil also carries beneficial organisms that promote crop nutrition. Previous research on tropical soils tended to focus on separate factors, but the soil health approach requires an integrated management of crops, soils, and soil biota. Soil biology is therefore central to this integrated approach, affecting both soil and plant health.

Soil biodiversity and its role in agroecosystem function have been largely ignored in the past. However, the application of molecular techniques and the ability to isolate nucleic acids from soils has opened up new frontiers for detailed studies on microbial diversity and its functions. Soil biota is being studied in terms of (1) functional groups and their roles in agroecosystem processes, such as the regulation of nutrient availability to plants and maintenance of soil structure, and (2) comprising a source of new genes and organisms of value to biotechnology.

Integrated approaches to plant and soil health aim to reduce crop losses to pests and diseases and to improve plant nutrition through a combination of genetic improvement, management by ecological principles, and targeted use of measures such as natural enemies, biopesticides, and judicious use of selected chemicals.

Soil management components must be a part of an agroecological strategy that highlights the conservation and enhancement of local natural resources, especially in "hot spots," that is, in areas with high risk of



*Soil structure and fertility can be improved through the management of crop residues, green manure, and soil biological activity.*

degradation. Strong emphasis is placed on developing methodologies that encourage participation and collective action, use of local knowledge, and adaptation of farm enterprises to local demands, conditions, and opportunities.

Current and future research on better soil management and health will focus on more integrated approaches that combine the sciences of soil biology, physics, and chemistry with crop management. Strong interaction with social sciences will also help incorporate a multi-stakeholder perspective to achieve better rural livelihoods.

### *Analysis of Spatial Information*

Spatial analysis involves a strong research and development linkage through the implementation, monitoring, and evaluation of adaptive management of land and other resources in key agroecosystems. The goal is to produce more from less land and at lower risk to the environment. The need to combine goals of sustainable land use with competitive agriculture requires better policy and decision making at several scales. Issues of competitiveness and agroecosystem health must be integrated in an uncertain spatial and temporal context that reflects diverse ecological, social, and economic functions.

Such an approach requires decision-support tools and models for analyzing different options and their trade-offs, taking into account both agroecosystem health and agricultural competitiveness at different scales. Rapid advances in the provision and handling of spatial information, combined with participatory approaches to planning, offer new opportunities for innovation in the areas of risk analysis, decision support, and action research.

At the field level, crop models can be used to appraise how improved germplasm or changed management can affect productivity, as well as critical resources such as soil and water. At the farm level, land management models can appraise how new options can affect the use of economic resources in the farm system and how this affects employment, income, productivity, and natural resource quality. Using GIS, farm performance can be scaled up to the watershed level, and collective action modeled to examine issues of resource use, including degradation or enhancement.

At the regional level the most promising crop species for specific socio-ecological niches can be identified. Exotic species with high income-generation potential can then be evaluated for their adaptability before costly and risky plant introduction are made. Land management models, whether at landscape, national, or regional scales, explore land use and environmental consequences of agriculture while incorporating a fuller consideration of issues such as accessibility, investment in infrastructure, spatial economics, and off-site effects.

Effective land management thus requires the development of decision-support tools that integrate crop models, farm-level economic decisions, GIS approaches to land management at different scales and the analysis of interactions among scales, and economic models of market behavior. These tools permit the identification of symptoms such as lack of competitiveness or poor agroecosystem health, while diagnosing the often mutually interactive relationships among causes and consequences to ultimately appraise interventions that may remedy imbalances. Using such models as decision-support tools can thus permit the analysis of the limitations and potential of



*Rapid advances in the provision and handling of spatial information, combined with participatory approaches to planning, offer new opportunities for innovation in the areas of risk analysis, decision support, and action research.*

land use in priority agroecosystems, providing frameworks for analyzing land use dynamics and using indicators of sustainability. Scenarios with options for sustainable land management can be developed at multiple scales and made available to interested stakeholders. Impact of innovations can be simulated with models and monitored through a combination of field measurements, surveys, and, in some cases, satellite images.

While partners in NARS will be the users of some tools, such as crop models or indicators, new partnerships with public institutions and NGOs concerned more with resource management, especially at a regional or spatial level rather than at the crop level, will be key to facilitating improved resource management. User-friendly interfaces for models and databases must be developed to become important assets for these partners. Furthermore, training of professionals in the use of decision-support tools and scenario-building methods will be essential. Data must be transformed into information, and information into actions that will achieve desired impact.

Research on land management will be especially complementary to other CIAT core competencies. The diagnosis and monitoring part of management will be based on the acquisition and analysis of socioeconomic data and of the biophysical data needed to evaluate agroecosystem health (indicators of, for example, soil quality, agrobiodiversity, and insect populations), in collaboration with scientists from the other competencies. Targeting improved germplasm; prioritizing agrobiodiversity conservation efforts; and managing soils, pests, and diseases all have a land management dimension that will benefit from integration of data and analysis between specialists in land management and those of the other core competencies.

Land management, especially in relation to the integrated management of watershed resources and spatial analysis, addresses the question, "What can or should be done with the natural and human resources of a spatially defined area or landscape over time to provide sustainable human livelihoods?" This question provides an entry point to analysis of different alternatives for land use and the trade-offs among them, some of which may not be agricultural. The issue of how to maintain or regenerate natural systems so that food and environmental services are provided on a sustainable basis is central to this type of analysis.

### *Socioeconomic Analysis*

Socioeconomic analysis provides methods for understanding how individual farmers and communities make decisions that are crucial to attaining agricultural competitiveness, agroecosystem health, and rural social capital. Decisions about which crops or varieties to grow or how to manage pests, soils, and land are all conditioned by farmers' objectives and resource constraints. Innovations in germplasm and pest, soil, or land management can be successful only if they correspond to the objectives and constraints of individual farm managers or communities. Consequently, understanding socioeconomic perspectives is key to setting the design parameters for innovations and for evaluating and assessing the impact of CIAT research outputs. In addition to outputs such as publications, models, databases, and policy recommendations, social scientists will contribute to the production of guidelines, manuals, and training materials for partners.

A broad range of conceptual and methodological capabilities will be required to meet these needs. Some of these can be provided by partner organizations, allowing CIAT to focus on a few strategic areas. The Center will



*Data must be transformed into information, and information into actions that will achieve desired impact.*

focus its social-science capacity in the areas of (1) organizational and institutional analyses; (2) multiscale and multi-actor modeling of agriculture and land use decisions and outcomes; (3) generation and management of local knowledge; and (4) monitoring, evaluation, and assessment of impact.

Many of CIAT's research goals and outputs are directly related to the ability of people to manage their resources in a more sustainable way. From integrated pest management to community watershed management, achieving impact often depends on the ability and willingness of individuals to work together. Cooperation often requires forgoing short-term individual gains for the sake of greater, but less certain, personal and social benefits in the longer term. Social scientists have a critical role to play in characterizing institutional and organizational contexts, including the incentives, options, and outcomes available to individuals and groups, and in determining how they will affect the adoption and impact of a technology or other innovation. How individuals perceive their options and the potential returns to cooperation versus individual action is often embedded in past experience and in social and cultural norms, as well as in the expected economic costs and benefits associated with different actions.

While individuals and groups base their decisions on a broad range of criteria, the basic decision-making process considers both benefits and costs, and actions and their consequences. In managing natural resources, individuals often find it difficult to know what the consequences of their actions will be, in either the short or long term. Assessing the consequences of many individual decisions is even more complex. One way of improving the ability of individuals and communities to assess the consequences of their decisions is through modeling. Increasing computing capacity, more and better data, and user-friendly interfaces will help scientists work with stakeholders to produce more useful models at different levels and scales. Social science analyses of objectives, incentives, and constraints at individual and social levels can contribute to the relevance of such models, and enhance their ability to provide useful insights for policy.

Understanding farmers' traditional practices and knowledge, and ways to incorporate such knowledge within the process of developing innovations is useful not only to develop more appropriate technologies but also to enhance the ability of stakeholders to better manage natural environments and the genetic diversity within them. Advances in agricultural anthropology, other social sciences, and GIS will make contributions to these areas. Partners such as NGOs, NARS, and AROs often have detailed knowledge about specific resources and/or regions, although none is typically engaged in systematic comparison and extraction of lessons that are relevant to developing technologies or policies.

Finally, a major contribution of social sciences at CIAT will be to monitor, evaluate, and assess impact. Although CIAT has a strong capacity to estimate economic impact, changes over the past decade in CIAT's goals, methods, outputs, funding environment, and partnerships have resulted in a dramatic increase in the need for evaluation and assessment. Donors are demanding more evidence of impact and of shifts in types of impact from production and income to improved sustainability and reduced poverty. Conventional economic impact analysis is proving unsatisfactory for achieving these latter objectives, and new assessment tools and communication strategies are needed. Research outputs now not only include germplasm and management practices, but also information, decision-support tools, databases, methodologies, and organizational practices. The complexity, process orientation, and long-term horizon



*Social scientists have a critical role to play in characterizing institutional and organizational contexts, including the incentives, options, and outcomes available to individuals and groups.*

associated with such outputs require new conceptual and empirical models and methods for their evaluation. Such methods will clearly require multidisciplinary and multi-stakeholder efforts to design and implement.

CIAT's comparative advantage lies in advancing knowledge, developing methods, and systematizing experiences to identify lessons learned. CIAT will conduct action research with partners that have specific development objectives and for whom methods and information will be needed. CIAT will not, however, attempt to achieve development objectives other than as an outcome of collaboration with partners. Actual field-level development will be facilitated by partners supported by CIAT training, methods, and information resources. CIAT and partners will monitor and evaluate impact together.

## A Research Agenda for Sustainable Rural Livelihoods

### *Principles for Setting the Agenda*

**L**ed by the vision of sustainable rural livelihoods that was derived from its mission, CIAT will deploy its research competencies to produce knowledge and technology that will contribute to achieving agricultural competitiveness, agroecosystem health, and social capital for rural innovation. The research agenda will evolve over time as solutions are found to specific challenges and as new challenges and opportunities emerge with advances in science and with changes in the conditions of competition, natural resources, and socioeconomic context.

Thus, the general strategy outlined in this *Strategic Plan* will be implemented through *Medium-Term Plans* that will specify detailed research objectives, organizational structure, and resource assignments. These *Medium-Term Plans* will cover spans of 3 years, and will permit periodic adjustment of the research plan, organization, and resource allocation. Because the elements of an appropriate research agenda for CIAT will inevitably evolve through different *Medium-Term Plans*, we must set out the principles that guide the implementation and adjustment of CIAT's research agenda.

Identification, with partners, of priority problems limiting sustainable rural livelihoods is of central importance. Partners in national programs, farmer organizations, and community-based organizations have a close firsthand familiarity with the constraints to sustainable rural livelihoods and the elements needed from research to overcome these constraints. CIAT will work with these partners in different regions as they set their priorities and research agenda, and CIAT's own research agenda will be formed in relation to them.

Identification of new opportunities presented by advances in science will also be important. Constant interchange with scientists in AROs is crucial to identifying new scientific tools and methods. Such interchange will be a major function of CIAT's core scientific competencies.

Having identified problems or opportunities in consultation with partners and through internal analysis, the contribution to CIAT's mission of overcoming these problems or exploiting these opportunities needs to be assessed. These appraisals of contribution to agricultural competitiveness,



*CIAT's comparative advantage lies in advancing knowledge, developing methods, and systematizing experiences to identify lessons learned.*

agroecosystem health, and rural social capital will be itself a subject of CIAT research and will be based on quantitative analysis where possible. But the Center will undertake research in promising areas, even if uncertainties exist about the potential outcomes or difficulties in their estimation.

Research problems or opportunities that contribute substantially to sustainable rural livelihoods have to be assessed in terms of feasibility. This constitutes first an appraisal of CIAT's capacity to undertake the proposed research through its core competencies. Research that falls outside of the Center's competencies is best left to other partners to conduct. Moreover, where alternative suppliers are better placed to research a particular issue or where CIAT does not have the capacity, CIAT will seek the active participation of partners in order to avoid counterproductive duplication or competition.

Additionally, the fundability of the research has to be evaluated. Stakeholder willingness to invest in research is a significant criterion of feasibility, especially as an increasing proportion of CIAT's resources is likely to come through restricted or targeted funding to support specific lines of research. Ultimately, all elements of the research agenda must have effective demand through stakeholder resource commitment, either as part of the global CGIAR agenda or through contract funding.

Commitment of research partners in national programs or AROs to coproduce a research result with CIAT will be an important criterion for establishing CIAT's research agenda. Partner commitment is not only a valuable confirmation of the importance of a research issue, but also contains an element of cost sharing, which makes implementing research more feasible. Thus, research partnerships will be a highly important part of setting CIAT's research agenda. Only a very small part of CIAT's research is expected to take place outside the framework of a real working partnership.



*CIAT will seek the active participation of partners in order to avoid counterproductive duplication or competition.*

### *Global and Regional Dimensions of CIAT's Research Agenda*

CIAT's research program is designed in the context of a global system for agricultural research, known as the Future Harvest Centers of the CGIAR. Because CIAT is part of this global system, much of its research will have a global orientation, for example, in the conservation of genetic resources or deployment of methods like participatory research. The global elements of the the Center's research agenda will link with regional research needs, and CIAT will tailor both its global and regional research activities to regional research agendas.

Of particular importance will be the priorities of Latin America and the Caribbean. CIAT is located in this region and will continue being particularly committed to responding to its challenges. However, in addition to its global germplasm research and its regional strategy for Latin America and the Caribbean, CIAT will also have specific strategies for the uplands of Asia and the midelevation agroecosystems of eastern and southern Africa. Thus, CIAT will work closely with partners in these three regions when developing its global and regional research activities.

In the context of CIAT's vision of sustainable rural livelihood, its experience, and the mandates of other centers in the CGIAR system, the midaltitude hillsides of Central America and the Andes will comprise the priority agroecosystem, thereby enabling CIAT to address a significant portion of rural poverty in Latin America. This focus also treats an environment that is potentially highly productive but which is clearly fragile and subject to serious degradation if natural resources are mismanaged. Resource

degradation in this agroecosystem can also have severe off-site effects downstream. The focus on hillsides also builds on and extends the orientation of CIAT's previous *Strategic Plan* for the 1990s.

Many of the problems and crops of the Latin American hillsides have very strong commonalities with midaltitude agroecosystems in eastern and southern Africa and with Asian uplands. These regions have comparable or greater numbers of poor than are found in the Latin American hillsides. Their environments are of similar importance, and are equally vulnerable to degradation. Given the priority assigned by the CGIAR to tackling poverty in Africa and Asia, where the greatest numbers of poor are, and given CIAT's current research portfolio and that of the other CGIAR centers, it makes sense for CIAT to orient its crop improvement and NRM research to include the problems of these regions, thus taking up a global approach to tropical hillside agriculture.

### *Global Research Outputs*

Key elements of the CIAT research agenda have a global reach to promote competitive agriculture, agroecosystem health, and rural innovation. Research on beans, cassava, and tropical forages can enhance agricultural competitiveness wherever these crops are grown. Research on NRM for hillside environments likewise contributes to agroecosystem health in the well-watered midaltitude tropics of Latin America, Asia, and eastern and southern Africa. Research on participatory research and rural *agroenterprises* should lead to *methodologies* that foster social capital for rural innovation and have potential for worldwide use.

### *Competitive agriculture*

Genetic resources conservation, characterization, and enhancement will be a major global output of CIAT contributing to competitive agriculture. Within the global system of the Future Harvest centers, CIAT has long had global mandates for conservation and improvement of germplasm of common beans, cassava, and tropical forages for humid and subhumid environments. Genetic improvement will increasingly be based on the use of new tools from biotechnology, especially molecular markers that accelerate breeding and the introgression of new traits from wild ancestors and closely related species to broaden the genetic base of crop cultivars.

**Beans:** Bean improvement will be closely linked to research networks in eastern and southern Africa, Central America, and the Andean region. Expected results include highly productive climbing beans for small farmers in warm environments; improved germplasm adapted to systems exposed to drought; higher levels of iron for improved nutritional quality, especially relevant to women's health; and advanced material in commercially attractive grain types. Mexico and Brazil will remain important partners. They have substantial breeding capacity and will take advantage of germplasm characterized and enhanced at CIAT. Increased collaboration will be sought with the genetic improvement programs of other Future Harvest centers working on grain legumes.

**Cassava:** Cassava improvement will focus on making it a competitive alternative for resource-poor farmers wanting to enter new markets, including those for starches and animal feed. Priority will be placed on both increased competitiveness through reduced production costs and improved product quality in terms of contents of starch and vitamin A (which is needed to help overcome nutrient deficiencies and improve human health). Through



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the Cassava Biotechnology Network founded by CIAT, advanced laboratories and national programs will be drawn into a coordinated effort that uses the most advanced techniques available for cassava improvement. The Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA) will be an important partner, together with the private sector and growers.

Furthermore, CIAT will participate with CIP and IITA in the Intercenter Roots and Tubers Research Committee to harmonize Future Harvest Centers' research on roots and tubers. IITA will also be a major strategic partner for cassava research in Africa. Asia will be an important region for cassava research, where the demand for cassava is diversifying and has great growth potential. Brazil's large national cassava research program will be a leading partner in Latin America. New systems for transferring genes will also be important. For example, genetic transformation may be much more effective than conventional plant breeding to make use of desirable genes within the cassava gene pool.



*Tropical forages research will yield multipurpose grass and legume germplasm with global potential for use as animal feed, production of organic material to enhance nutrient cycling, and recuperation of degraded lands or use as a soil cover or barrier crop to arrest soil erosion.*

**Tropical forages:** Tropical forages research will yield multipurpose grass and legume germplasm with global potential for use as animal feed, production of organic material to enhance nutrient cycling, and recuperation of degraded lands or use as a soil cover or barrier crop to arrest soil erosion. Focus will be mainly on smallholder systems in the hillside agroecosystems of Latin America, Africa, and Asia. Nevertheless, multipurpose grasses and legumes, including herbaceous and shrubby species, also have important potential in other agroecosystems, especially the savannas and forest margins. Within the context of the global system of Future Harvest centers, CIAT's forage mandate will be for species adapted to the subhumid or humid tropics and its forage research will continue to be closely linked to the CGIAR Systemwide Livestock Program based at ILRI.

### Agroecosystem health

Improving agroecosystem health integrates natural resource management research with (1) CIAT's global work on agricultural competitiveness through improving germplasm of beans, cassava, and forages; and (2) CIAT's research on rural innovation that focuses on participatory methods and agroenterprises. To integrate these various dimensions of sustainable rural livelihoods, CIAT's global NRM research focuses on soils, integrated pest management, and land management.

**Soil health:** CIAT convenes the CGIAR Systemwide Soil, Water, and Nutrient Management (SWNM) Program. This program links soil research at key ecoregional sites to enhance research efficiency of the centers and their partners and reduce duplication by using common methods, databases, and models across regions. Research outputs include soil management technologies, together with indicators and methods to monitor their environmental and socioeconomic impact. CIAT's global research concentrates on selecting resource-use-efficient crop and forage germplasm for hillside agroecosystems, and on developing management systems for crop residues and green manure to enhance nutrient cycling, improve soil structure, and reduce erosion in the hillsides. For this research, a strategic ally is the TSBF, which has national partners in the midaltitude systems of eastern and southern Africa.

**Integrated pest management:** Within the CGIAR Systemwide Program on Integrated Pest Management, CIAT leads a consortium for research on the whitefly, a globally important pest. This research integrates research on the

pest itself, the viruses for which it is a vector, resistant germplasm, and pest management options. Overcoming this pest would contribute both to agroecosystem health through reduced pesticide use and to agricultural competitiveness through reduced losses to the pest and the viruses it transmits.

**Land management:** CIAT's global approach to integrated natural resource management research takes a landscape management approach. Improved resource management for agroecosystem health requires environmental sustainability indicators, decision-support systems, and tools for extrapolation. CIAT convenes the Consortium on Spatial Information for Agricultural Research, which seeks to strengthen synergies among Future Harvest centers in their research on GIS. CIAT's own research includes, among other elements, the development of methods to understand poverty from a spatial perspective and models to understand the effects of global climatic change on tropical agriculture.

### Rural innovation and social capital

**Participatory research:** Research on participatory methods develops techniques that can globally promote social capital for rural innovation. Research has focused on developing approaches to participatory plant breeding and participatory NRM that have had wide applicability. The methods developed are flexible and allow for considerable adaptation to local circumstances. Strategic research on these methods and their effectiveness is of priority and is conducted through the CGIAR Systemwide Participatory Research and Gender Analysis (PRGA) Program, coordinated by CIAT. These methods will be disseminated globally through the Future Harvest centers and other partners.

**Agroenterprises:** Likewise, research to develop methodologies for designing and establishing small rural agroenterprises that link market opportunities and processing technologies with environmentally sound production practices will produce principles that can be applied globally. Emphasis is on methods and decision-making tools and on training national personnel to ensure their broad use and dissemination. These research outputs will contribute not only to fostering rural innovation, but also to competitive agriculture by broadening small farmers' access to growing markets for high-value products. Primary users of these outputs are technical personnel in rural development and rural policy makers. This work is closely linked with that of other Future Harvest centers, in particular, with CIP in Asia and IITA and ICRAF in Africa.

### Regional Strategy for Latin America and the Caribbean

CIAT's global research outputs are highly relevant to Latin America and, in fact, initially entered CIAT's research agenda because of their importance to the region. However, research that is specifically targeted to Latin America and the Caribbean forms an additional part of CIAT's research strategy. This research concentrates on rice and tropical fruits, and the Amazon Basin and savannas agroecosystems. While CIAT focuses on strategic research, adaptive research and technology transfer remain important tasks for national systems.

### Rice

Rice is the most important food grain for tropical America, and rice research is of high priority to the region. Partnerships with rice growers and the



*Research on participatory methods develops techniques that can globally promote social capital for rural innovation.*

private sector play an important part in financing and implementing a regional rice program through the Latin American and Caribbean Fund for Irrigated Rice (FLAR). Likewise, CIAT has a strategic partnership with the government of Colombia, which supports rice research through the Ministry of Agriculture and Rural Development. Similar partnerships are being developed with other countries in the region. CIRAD (France) is another important strategic partner. Priority is given to strategic research that enhances the competitiveness of regional rice production. One example is research on controls of pests and diseases, including the *hoja blanca* virus—found only in the Americas—and rice blast.

Increasing yield and quality while enhancing diversity is another challenge that is being addressed by introgressing new plant types being developed by IRRI's global rice program. CIAT's own strategic research aims to broaden the Latin American rice gene pool by crossing with wild relatives. Both large and small rice growers, using similar production systems, can benefit from the products of CIAT's research. The Center will continue playing an innovative role to support the production of this basic staple of the economically disadvantaged populations of Latin America.

### Tropical fruits

Production of tropical fruits has been doubling approximately every 20 years. Until recently most tropical fruit in the developing countries was marketed fresh, but in Latin America and Southeast Asia there has been a remarkable increase in the consumption of processed fruits. Production of most individual fruit species is small and, like exports, concentrated in a few countries. Benefits of development of a particular species tend to be localized, but due to the high value of the produce and the intense use of labor the impact on incomes at the local level may be immense.

Due to the diversity of fruit species, CIAT does not intend to assume mandate responsibility for the conservation of fruit germplasm or to establish an autonomous genetic enhancement program for any fruit species. Instead, the Center will build on its expertise in sophisticated information management techniques to provide national and local agencies with information. This could include information for a whole range of fruit crops on suitable areas for production of different crops, availability of germplasm, the presence of diseases and pests in different areas, potential management practices, quality control, and postharvest management. CIAT proposes to deploy its core research competencies to provide strategic research to support, through cofinancing, national fruit research on specific priority problems for which effective demand exists and which would contribute meaningfully to CIAT's mission and vision.

CIAT efforts on fruits will be only a small part of a continuum of activities carried out by several organizations in the public and private sectors. Strong commitment by national agencies or producer organizations is a prerequisite for success. Because of its strong partnerships in Latin America, especially with Colombia, CIAT will first seek to develop collaborative activities in the region. However, because of the great potential of tropical fruits outside their centers of origin, CIAT will be alert to the potential to catalyze global exchange of information, germplasm, and technology.

### Amazon Basin and savannas

The frontier savannas and forest margins of South America are agroecosystems of great environmental significance. The Amazon Basin is



*The Center will provide national and local agencies with information for a whole range of fruit crops on suitable areas for production, availability of germplasm, presence of diseases and pests, management practices, quality control, and postharvest management*

widely recognized as a crucial pool of global biodiversity with a key role in global carbon balances. The savannas likewise may play a major role in carbon sequestration and, in addition, represent a resource for agriculture that is making an increasing contribution to food supply and agricultural competitiveness in South American countries. Because both regions are relatively underpopulated, the absolute number of poor people is not high in either agroecosystem. Nevertheless, the incidence of poverty among the inhabitants of both agroecosystems is high. CIAT also has longstanding partnerships for research in both agroecosystems.

Research for the Amazon Basin will focus on developing and introducing socially and environmentally progressive land use systems. Priority will be placed on intensifying land use in ways that decrease negative environmental impact and improve small-farmer incomes. Conservation of genetic resources under threat from land use or climatic change will be important. Reduction of carbon emissions and economic losses associated with poor fire management will be of concern, as will land use changes that exacerbate vector-borne human health problems. Rehabilitation of degraded pastures could absorb carbon, reduce methane emissions, and decrease pressure on forest resources. Among the Future Harvest centers, CIFOR, ICRAF, and IPGRI will be key partners in this work, while Brazil will be a major national partner.

Research for the Latin American savannas will be closely related to other aspects of CIAT's agenda. Research on upland rice will be important, and so will research on multipurpose forages and, potentially, fruits. Because soils degrade rapidly under field crops in the savannas, research to overcome problems of acidification and develop a fertile arable layer will be important. Land management issues will also be critical as these vast lands are settled and brought under agricultural use. Colombia is a key partner in this research.

CIAT will produce research outputs that are useful in other Latin American agroecosystems. For example, semiarid Northeast Brazil has among the largest numbers of poor people in South America, whereas the favored irrigated lowlands of the rice agroecosystem are important in Latin America's food economy. Nevertheless, to maintain an adequate level of focus in its research, CIAT cannot give the same degree of attention to all Latin American agroecosystems. Priority will therefore be given to the hillsides of Central America and Andean countries, together with the savannas and Amazonian forest margins.

### *Africa Regional Strategy*

Rural poverty is widespread throughout Africa, affecting an increasing number of people, even in highland and midaltitude areas that, climatically, are relatively favored. Infrastructure is poor, market development is incipient, smallholder farmers have scarce resources, and communities have little bargaining power in the globalizing economy.

CIAT will contribute to achieving sustainable rural livelihoods in these smallholder mixed-farming systems in the highland and midaltitude areas of central, eastern, and southern Africa. The Center will also support the research and development efforts of regional and national partners through research that fosters agricultural competitiveness, agroecosystem health, and social capital for rural innovation. This work will complement that of other Future Harvest centers, for example, through continued participation in the ICRAF-led ecoregional program known as the African Highlands Initiative.



*Research for the Amazon Basin will focus on developing and introducing socially and environmentally progressive land use systems. Priority will be placed on intensifying land use in ways that decrease negative environmental impact and improve small-farmer incomes.*

Strategic research by CIAT will be linked with research by national partners in Africa to address regional priorities while enhancing the output of international public goods. Collaborative research between Africa-based CIAT scientists and NARS scientists will take advantage of outputs produced by CIAT elsewhere, as well as from Future Harvest centers and other sources within the region. In addition, collaborative research in Africa will produce strategic byproducts that will be fed into CIAT projects for extrapolation to Latin America and Asia.

Particular attention will be given to assisting African NARS in institution building, networking, and training to promote the use of results from NARS/CIAT collaborative research, thereby spreading their impact. Stronger linkages will be developed between research on strategic issues in Latin America and intensively farmed areas of Asia with research in Africa to enhance synergies. Strategic research at CIAT will support research in Africa that will be linked with development-oriented institutions. Priorities will be derived in close consultation with national systems and through subregional research organizations.

CIAT's contribution will be built on its competencies in agrobiodiversity and genetics (especially for beans, cassava, and forages), ecology and management of pests and diseases, soil ecology and management, spatial analysis, and socioeconomic analysis through collaborative research and development projects. Priority will be given to strengthening community-based resource management and links between the informal and formal research sectors through the promotion of participatory approaches to research and development, the provision of decision-support tools, and the integration of germplasm and natural resource management approaches.

Enhancing bean germplasm will continue being an essential component of support to the regionally owned bean networks. An increased collegial role with IITA and cassava networks will be sought for enhancement in that crop. Germplasm of multipurpose forages, fruits, and other income-generating crops from Latin America will provide potential new opportunities for Africa. Work will continue in areas where CIAT has comparative advantage.

Soil health is a critical issue for African farmers and will be a high priority for CIAT. Emphasis will be on soil biology, both to enhance nutrient cycling and control soil-borne pests and pathogens. A strategic alliance with TSBF will be critical, while work will also be done through the CGIAR's SWNM Program.

Consultations with African partners suggest that other priorities will include participatory research; integrated pest management (including whitefly through the CGIAR Systemwide Program on Integrated Pest Management); decision-support systems and tools, including GIS; methods for rural agroenterprise development; and impact assessment. Climate change is expected to emerge as an increasingly important issue.

The approach will be demand-driven and will empower rural communities in decision making on problem definition, technology development (e.g., participatory plant breeding), and NRM. Participation of women, who are responsible for much of Africa's food production, will be especially important. These experiences will be scaled up with partners.



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## Asia Regional Strategy

In Asian uplands, rural poverty is widespread, justifying CIAT's focus on those areas. Usually, these areas have less agricultural potential than do the lowlands, and also have poor infrastructure. In southeast Asia, for example, uplands are largely populated by smallholder families with scarce resources, particularly land and water. Often, upland families belong to marginalized minority groups.

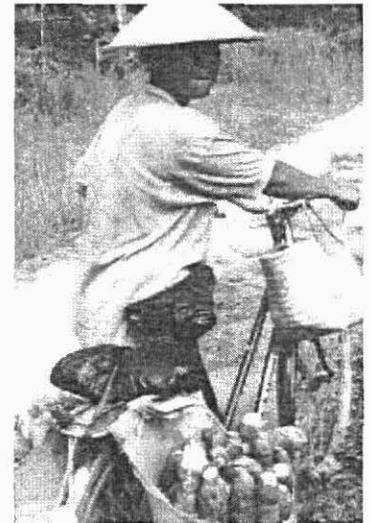
Upland farming systems are changing rapidly because increasing populations demand an intensification of resource use that is often unsustainable. The challenge is to work with NARS to help farmers manage this process of intensification with information and technology options to generate sustainable rural livelihoods by improving agricultural competitiveness, agroecosystem health, and rural innovation through social capital.

CIAT research has developed germplasm, information, and participatory research approaches that offer new opportunities for enhanced livelihoods and improved resource management, especially in Southeast Asia. Many of these outputs have been developed for hillside smallholder systems in South America, which share with Asia a wide range of soils, climates, available resources, farming systems, and socioeconomic constraints. At the same time, CIAT and national scientists in Asia have been working with farmers at various reference sites. This collaborative research develops alternatives for upland systems that not only meet the needs of Asian farmers and communities, but also comprise global public goods that are relevant to Latin America and Africa.

CIAT will continue focusing on the integration of germplasm improvement and NRM through a systems approach. In Southeast Asia CIAT has strengths in the commodity areas of cassava and forages, and can complement this with expertise, methods, tools, and experience in participatory research, development of partnerships, facilitation of institutional change, the use of GIS in interpreting land-use dynamics, nutrient cycling, agroenterprise development, and impact assessment. Biophysical research will be complemented with input from social scientists.

Production systems research in cassava and forages will be complemented by systems research at the community or watershed level. The sites of this systems research will allow outputs generated in Center-based projects to be evaluated in Asia and for strategic research on the processes of technology development and enabling institutional change.

Strong partnerships have been developed with crop and livestock research and development organizations and universities in China, Indonesia, Lao PDR, Malaysia, Philippines, Thailand, and Vietnam. CIAT will continue aligning its research with that of other Future Harvest centers. For example, CIAT's work complements that of IRRI in upland areas with inputs for commodities other than rice and with its systems perspective. CIFOR and ICRAF focus on the management and integration of trees in upland systems. Expertise in the integrating of improved forages into smallholder farms complements research by ILRI on animal health and nutrition. CIAT will contribute to the Ecoregional Initiative for the Humid and Sub-Humid Tropics of Asia, led by IRRI at sites in Thailand and Vietnam. CIAT strategic research will support and complement national efforts while avoiding duplication.



*CIAT research has developed germplasm, information, and participatory research approaches that offer new opportunities for enhanced livelihoods and improved resource management, especially in Southeast Asia.*

## Organizational Principles

**T**his *Strategic Plan* lays out broad principles through which CIAT will organize itself, while the specific details of organization will be presented in periodic *Medium-Term Plans*, which are issued about every 3 years or as appropriate. These key organizational principles include integration with global and regional strategies, management of scientific competencies as key core assets, and integration into multidisciplinary teams organized as research projects around problems and opportunities. The relationship between these organizational features and the overall vision of CIAT is illustrated in Figure 2.

### *Integration with Global and Regional Strategies*

As a Future Harvest center, CIAT is linked with a global agricultural research system supported by the CGIAR. CIAT's own research strategy is developed in the framework of the CGIAR's global priorities so that CIAT's comparative advantage is expressed in a global system that seeks complementarities and synergies while minimizing duplication. CIAT's membership in this global system provides the Center with rich opportunities for partnerships with similar organizations and a context in which to seek its own particular niche.

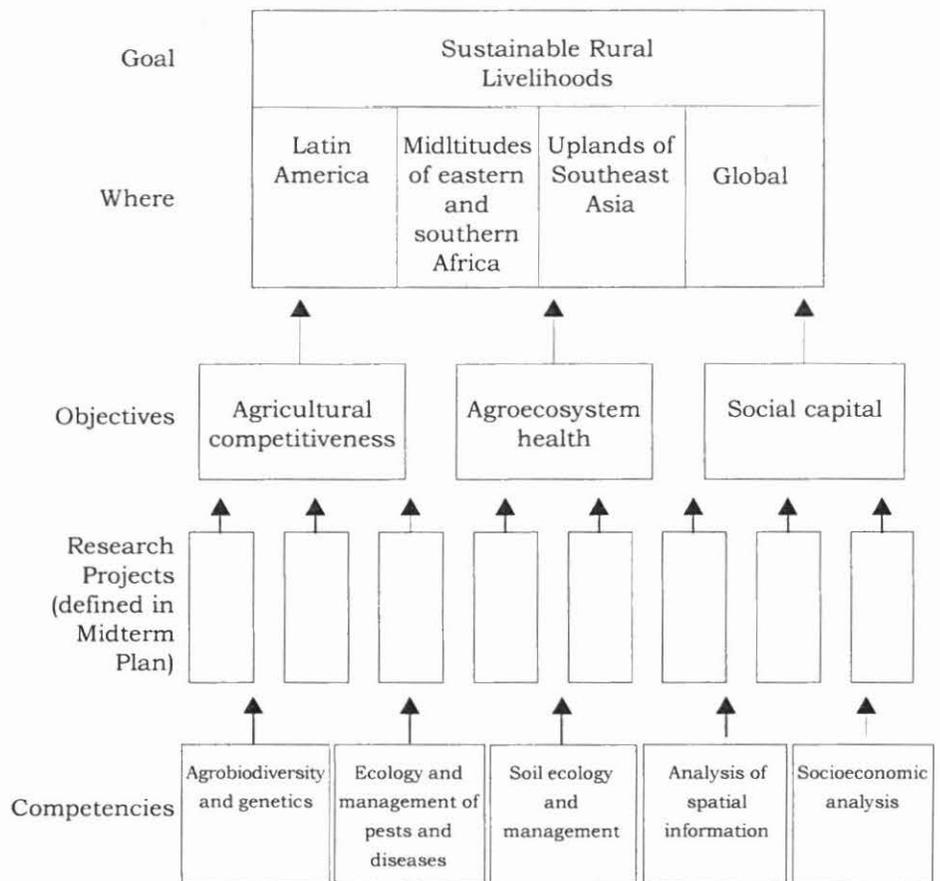


Figure 2. CIAT organization, 2001-2010.

Participation in the Future Harvest centers' agenda setting will be a major responsibility for CIAT management, because it will provide significant input into defining CIAT's particular global agenda.

Equally important is CIAT's integration into regional research strategies in Latin America and the Caribbean, eastern and southern Africa, and Asia. The different roles CIAT plays in these regions can be derived only through close articulation with the NARS agenda, increasingly expressed through NARS-led regional forums. CIAT will organize itself so as to make effective contributions to regional and NARS priorities.

*Regional coordinators for CIAT in Latin America and the Caribbean, Africa, and Asia will be the focal points for dialog with NARS as their national and regional agenda are set, and options for CIAT supporting these agendas are assessed. Regional coordinators will be responsible for articulation with the regional agenda, and for ensuring appropriate coordination with other Future Harvest centers working in the region.*

Regional coordinators will also identify research opportunities for CIAT projects and competencies, facilitate the establishment and management of strategic alliances with NARS in research partnerships, mobilize resources to support these partnerships to coproduce priority research outputs, and will deliver these outputs to development efforts that will ensure they reach end users.

While CIAT will have regional research strategies, it will not operate through autonomous regional programs. Instead, its research will be implemented through projects that usually operate globally across regions to maximize the flow of results from international research, prevent duplication, ensure the use of best-practice methods, and take advantage of cross-site learning opportunities. Regional coordinators will help articulate NARS strategies, form and cultivate partnerships, and mobilize resources, but research activities will be implemented through research projects.

### *Core Scientific Competencies*

CIAT's scientific competencies (that is, communities of scientists having different but interrelated specialized skills) and the infrastructure that enables them to work effectively are CIAT's long-term core assets, both human and physical. Because we have already discussed in detail the substance of these core competencies in agrobiodiversity and genetics, ecology and management of pests and diseases, soil ecology and management, analysis of spatial information, and socioeconomic analysis, only the organizational features of the scientific competencies will be discussed here.

The core scientific competencies will constitute the key institutional assets to implement CIAT's global and regional agenda through multidisciplinary projects. The scientific communities involved will play a major role in knowledge management to ensure scientific quality and that CIAT has the capacity to use the most advanced methods to meet its research objectives. The scientific communities will advise on the integration of specific scientific expertise, and will be a major element in the recruitment of new scientists. Each community will manage the laboratories and capital equipment that it needs for strategic research. CIAT resources will be managed to ensure adequate staff and facilities for each competency and the appropriate balance between them.



*Equally important is CIAT's integration into regional research strategies in Latin America and the Caribbean, eastern and southern Africa, and Asia. The different roles CIAT plays in these regions can be derived only through close articulation with the NARS agenda.*

## Research Projects

Multidisciplinary project teams integrated around the solution of problems and the exploitation of new opportunities are the central organizational feature for the implementation of CIAT's research program. Regional strategies help orient and facilitate the implementation of research by project teams. The scientific communities help manage knowledge and contribute human and infrastructure inputs that are deployed flexibly so that the project teams may implement research. The set of projects in the CIAT research agenda will evolve over time as problems are overcome and new problems or opportunities arise.

Project teams are responsible for the detailed planning and implementation of output-oriented research. As is standard in the CGIAR system, and to provide a clear framework to integrate the work of diverse scientists and partners, systematic, detailed research planning will be carried out to produce project log frames and individual work plans. These will also provide clear milestones to measure progress. Impact assessment will be an integral part of planning and monitoring the research project's progress.

Project teams will foster a culture of cross-boundary teamwork and a results-oriented approach. Projects need to integrate research, relationships with partners, and resource mobilization. Essentially, all project research will be conducted in collaboration with national partners and AROs. To be effective, projects need to coproduce their research outputs with partners who are close to the problems and provide links for development and with partners who can offer opportunities for using the most advanced research techniques in rapidly changing scientific fields. Project teams need to have internal leadership skills to manage these partnerships.

To support these partnerships and to sustain CIAT's own research programs, project teams will have substantial responsibility for resource mobilization and management of donor relationships. Because few, if any, research areas can expect to enjoy unconditional long-term financing, project teams must concern themselves with resource mobilization. Supported by senior management and specialized central services, project teams have advantages in resource mobilization through their intimate knowledge of the problems, personal relationships with partners, and enthusiastic engagement with the issues being studied.

### Linking Research with Development

For CIAT, science is a tool to promote development through sustainable rural livelihoods. Because the Center does not see science or knowledge as an end in itself, it is committed to linking its scientific results with processes of development to actually affect the lives of the disadvantaged. The transformation of scientific findings into outcomes for development needs to be actively pursued through the dissemination and marketing of research outputs.

An integrated approach to land management contributes to linkages between research and development by engaging in participatory processes of land-use planning, natural resource management, commodity food chain improvement, and social capital building with local and national stakeholders. In this way research contributes actively to the development process.



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Research in areas such as participatory methods, agroenterprise development, and impact assessment all directly contribute to this by providing a better understanding of the linkages between development and research. Other important mechanisms for linking research products to development are training, educational activities, and communications and publications (including electronic publications).

To effectively link research outputs with development, a variety of activities need to be undertaken. New partners need to be specifically identified on the basis of their capacity for innovation for development. Pathways between research outputs and development outcomes have to be fully mapped out and better understood to enhance the efficiency of this process. Strategies for communication of results and capacity building for their use have to be devised and implemented. These need to be carried out through all CIAT projects, but central training, communications, and development of capacity can enhance these efforts.

### *Management Team*

The director general will lead a team of senior management that will provide overall coordination, leadership, and vision for CIAT. The management team (MT) will be responsible for ensuring the relevance of the Center's work in a changing context. Harmonization of CIAT's strategy with the regional and global strategies of the CGIAR and other Future Harvest centers will be of high priority and will involve intense interaction at a senior level with NARS partners, CGIAR members and centers, and civil society and AROs.

Resource mobilization to permit the implementation of CIAT's strategy will be an important function of the MT. Likewise, scientific management to ensure the strength of the core scientific capacities and timely implementation of research will be another crucial function of the MT.

The MT will oversee the provision of support services to research, including central finance and administration, and will manage CIAT's infrastructure and assets. In a changing world of intellectual property rights, the MT must keep up with evolving national and international policies to ensure that CIAT's intellectual assets remain in the public domain and that private users appropriately share costs of these assets' development.

The MT will be appointed by the director general and will provide him/her with team support. MT members will have both individual and collective responsibilities. Transparency and shared commitment to common goals are important values. Rather than being restricted to a narrow or elitist base, the tendency will be for the MT to be open, to the point of bringing in participation where possible.

### *Board of Trustees*

The Board of Trustees bears ultimate responsibility for the overall health and functioning of CIAT. It will ensure that policies are in place so that CIAT's objectives, programs, and resources are aligned with its mission and charter. The Board monitors the implementation of policies and programs by the director general and approves plans, program objectives, strategies, and budgets. Membership must be appropriately diverse in terms of management and scientific expertise.



*Pathways between research outputs and development outcomes have to be fully mapped out and better understood to enhance the efficiency of this process.*

## *Working Environment*

A staff that is diverse in terms of gender and culture contributes to improved organizational performance by broadening the pool of skills, talents, perspectives, and ideas within the organization, thereby leading to increased innovation and creativity. Oriented by principles of gender equity and cultural pluralism, CIAT's Board and MT undertake to provide a working environment that will permit staff to achieve the highest level of individual and Center performance.

## **Mobilizing Resources for the Vision**

**F**inancial resources are required to convert vision into reality. Resources for overseas development assistance (ODA) received from high-income countries continue to be CIAT's financial mainstay. However, these resources have decreased steadily every year since 1989. Total ODA has fallen during most of this period, and the priority given to agriculture by countries offering ODA has declined dramatically, with many ODA agencies no longer having offices or programs dedicated to agriculture. At the same time, ODA has become increasingly restricted to specific, short-term, development outcomes, thereby both reducing flexibility in resource use and constraining the ability to undertake long-term strategic research.

Although the program of change in the CGIAR might conceivably lead to revived financial commitment from ODA sources, projections prepared by the CGIAR Finance Committee find that presuming that ODA will remain constant is optimistic, and that further decline is far more probable. Because ODA constitutes such a large share of CIAT's resources, continued attention to mobilizing these resources must remain high, even though fresh financing from new sources is most likely to be needed to maintain even the current levels of CIAT's efforts.

Increased mobilization of resources from tropical countries is a priority for both the CGIAR and CIAT. Experience demonstrates that investment in CIAT by tropical countries is conditional on joint commitment to specific outputs and is greatly facilitated by the physical presence of CIAT's research in the investing country. CIAT will seek to attract potential investors in the tropics to those elements of its research that would be relevant to CIAT's mission and to public institutions, quasipublic associations, and private enterprises. Expanded commitment by tropical countries to CIAT will be crucial to the Center's vitality.

Other, non-ODA, sources of public funding from donor countries will also be explored. Because CIAT is primarily a research institution, rather than a development agency, the tapping of resources for science and technology would be especially appropriate. Although such resources cannot be expected to constitute a major part of financing, they would be especially strategic.

The two areas with the most potential for enhanced resource mobilization, thus helping to compensate for the expected decline in ODA, are seen in the report commissioned by the CGIAR Finance Committee to be philanthropic agencies (foundations, corporations, and private entities) and social marketing relationships with the private sector. CIAT has already moved forward to further tap philanthropic sources and expects to make further progress in attracting additional support. Social marketing



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relationships with the private sector are also being explored, and are believed to offer significant future opportunities.

All these efforts for resource mobilization clearly entail an investment in stakeholder relationships that was not required before the drop in unrestricted ODA. CIAT has been investing in public awareness and resource mobilization and, to fill the gap that will be created by further erosion in ODA, will need to significantly increase such investments.

## Implementing the Strategic Plan

**T**his *Plan* sets out a strategic vision of sustainable rural livelihoods toward which CIAT can conduct research that will contribute to the essential conditions of competitive agriculture, agroecosystem health, and social capital for rural innovation. CIAT will work toward this vision through five core competencies: agrobiodiversity and genetics, ecology and management of pests and diseases, soil ecology and management, land management, and socioeconomic analysis. CIAT's research will consistently be a part of the global agenda of the Future Harvest centers. CIAT will organize itself around *multidisciplinary, goal-oriented research teams that will contribute to the regional research agenda of national research systems in Latin America, eastern and southern Africa, and Southeast and East Asia.*

The clear but broad principles of this *Plan* will be further operationalized in close consultation with key stakeholders. National systems in different regions are currently embarking on a process of refining regional priorities to articulate better with the global system of Future Harvest centers. CIAT is participating in this process, and will help define specific research activities for the next few years. At the same time, CIAT is participating in the program of change that the CGIAR's global research system is undergoing. Such participation will certainly affect CIAT's future work and the definition of its program's specifics.

Based on the principles of this *Plan*, and refined through consultation with stakeholders, CIAT will develop a series of 3-year operational plans that will:

- Identify key alliances with partners for doing research together
- Specify staffing for the core competencies
- Define concrete research outputs with clearly marked milestones for delivery
- Plan resource allocations and financing
- Plan monitoring and evaluation



*CIAT will organize itself around multidisciplinary, goal-oriented research teams that will contribute to the regional research agenda of national research systems in Latin America, eastern and southern Africa, and Southeast and East Asia.*

## List of Acronyms and Abbreviations Used in the Text

AROs	Advanced research organizations
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Centre for International Forestry Research
CIP	Centro Internacional de la Papa ( <i>International Potato Center</i> )
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement ( <i>Centre for International Cooperation in Agricultural Research for Development</i> )
CLAYUCA	Consortio Latinoamericano y del Caribe de Apoyo a la Investigación y Desarrollo de la Yuca ( <i>Latin American and Caribbean Consortium to Support Cassava Research and Development</i> )
FLAR	Fondo Latinoamericano y del Caribe para Arroz de Riego ( <i>Latin American and Caribbean Fund for Irrigated Rice</i> )
GIS	Geographic information systems
ICRAF	International Centre for Research in Agroforestry
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
Lao PDR	Lao People's Democratic Republic
MERCOSUR	Mercado Común del Sur ( <i>Southern Common Market</i> )
MT	Management Team (of CIAT)
NAFTA	North American Free Trade Agreement
NARS	National agricultural research systems
NGOs	Nongovernmental organizations
NRM	Natural resource management
OECD	Organization for Economic Cooperation and Development
ODA	Overseas development assistance
SWNM	CGIAR Systemwide Soil, Water, and Nutrient Management Program
TSBF	Tropical Soil Biology and Fertility Programme
WTO	World Trade Organization