Improved Beans for Africa and Latin America

The Challenge

Beans are the most important food legume for about 300 million people, most of them in the developing world. Referred to as the "poor man's meat," the crop provides an inexpensive food for poor consumers. Beans rank second as a source of protein in eastern and southern Africa and fourth in tropical America, where they were domesticated. The crop is especially important in the diets of women and children. Beyond their contribution to human nutrition, beans have considerable economic importance, providing income for millions of smallholders. Global production is valued at about US$11 billion annually.

In Latin America bean production has increased significantly over the last decade as a result of higher yields, while the area planted has declined. The annual rate of increase in production now exceeds the pace of population growth, with a resulting increase in per capita consumption. In many areas where farmers have intensified bean production, however, excessive pesticide use has become a serious problem. Another challenge for research is the extensive cultivation of beans on land characterized by low soil fertility.

Although yields in Africa have increased modestly during recent years, the rate of increase in bean production still lags behind population growth. Full realization of the crop's potential to combat hunger and poverty in this region requires a major research effort aimed at overcoming key constraints, including low soil fertility, drought, and certain diseases and insect pests.

Objective

To raise bean productivity in Latin America and Africa by improving crop germplasm in cooperation with national programs through regional networks

Outputs

- Germplasm showing higher yields, resistance to major diseases and insects pests, and tolerance to low soil fertility and drought
- Effective breeding strategies to increase yield potential and improve plant type
- Information that contributes to the development of strategies for integrated pest management

Benefits

New bean germplasm will benefit small-scale farmers by increasing their income from bean production and by reducing the hazard posed by pesticides to human health and the

environment. Both rural and urban consumers, particularly women and children, will gain from higher intake of protein and micronutrients.

Strategy

Bean scientists at CIAT headquarters maintain a comprehensive program of germplasm improvement, based on solid expertise in plant breeding and other disciplines. They draw on the rich array of genetic diversity represented in the Center's gene bank and take advantage of new tools made available by specialists in biotechnology and in geographical information systems. In this work CIAT staff work closely with the members of national and regional bean networks as well as with advanced institutions in the industrialized world.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia
The Center has many years of experience in developing bean germplasm, devising improved methods, and supporting regional networks.

Bean research networks in eastern and central Africa (ECABREN), the Southern Africa Development Community (SADC), the Andean zone (PROFRIZA), and Central America (PROFRIJOL)
National programs participating in these networks have compiled an impressive record of achievement through cooperative research. Several have complete multidisciplinary teams capable of addressing a wide range of crop constraints and of supporting research in neighboring countries.

Pan-American School of Agriculture, Honduras
The school is widely recognized for its effective programs in germplasm improvement, human resource development, and extension of improved technology.

National Institute for Agricultural Research (INRA), France
In recent years the institute has carried out important physiological studies on biological nitrogen fixation in beans under stress.

Bean-Cowpea CRSP, USA
This consortium of US universities offers expertise in biotechnology that can increase the efficiency of plant breeding.

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Regional Bean Networks in Sub-Saharan Africa

The Challenge

Nutritionists characterize beans as "a nearly perfect food" because of their high protein and micronutrient contents. The nutritional benefits of the crop are especially important for Africa, where protein deficiencies and malnutrition plague millions of poor people, particularly women and children.

Beans grow on more than 3 million hectares in Africa, cultivated for subsistence and increasingly as a cash crop by poor farmers, most of them women. In Rwanda alone, 95 percent of all farmers grow beans, which provide 32 percent of all calories and 65 percent of all protein consumed. Although yields in Africa have increased modestly during recent years, the rate of increase in production still lags behind population growth.

Given the important place of beans in the region's food system and agricultural economy and several striking recent successes in African bean research and development, national programs and their international allies must make renewed efforts to resolve the most persistent production constraints, including low soil fertility, drought, certain diseases and insect pests, and the slow dissemination of new seed.

Objective

To improve bean productivity in sub-Saharan Africa by deploying improved germplasm that helps solve major constraints, by promoting the development of sustainable cropping systems, and by fostering the development of networks for adaptive research

Outputs

- Improved gene pools, breeding populations, and mixtures with multiple stress resistance (their distribution is targeted through classifying bean environments based on agroecological and biological data)
- Stronger national research capacities and more effective priority setting in regional bean networks under the auspices of regional associations of national institutions
- Ecologically sensitive practices for crop, soil, and pest management
- Nonformal methods of rapid seed production and distribution

Benefits

The continued exchange of improved seed and research methods within the region will improve the efficiency of national programs in developing new germplasm and other technology. This in turn will lead to more timely release of high yielding germplasm that matches farmers' seed

preferences and is resistant to major diseases and pests and tolerant to low soil fertility. Stronger national programs will also be capable of providing technology that helps farmers maintain soil fertility, manage diseases through nonchemical methods, and improve the crop's tolerance of pest attack. Effective approaches to small-scale seed production will accelerate the spread of improved seed. The combined effect of these improvements will be to strengthen the contribution of beans to food security and poverty alleviation in Africa, particularly among women.

Strategy

The project's research strategy consists of three main elements. The first involves strategic research at CIAT headquarters that takes advantage of the Center's research infrastructure, experience in germplasm development, and easy access to Latin America's wealth of bean genetic diversity. The second element is a comprehensive program of research carried out by Center scientists based in Africa. This program is wedded to the third and main element: a network of African national programs, which set regional priorities, allocate resources, manage adaptive research projects, and share the results with colleagues in neighboring countries.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia
The Center offers many years of experience in developing bean germplasm, devising improved methods, and supporting regional networks.

Eastern and Central Africa Bean Research Network (ECABREN) and the Southern Africa Development Community Bean Research Network (SABRN)
National programs participating in these networks have compiled an impressive record of achievement through cooperative research. Several have complete multidisciplinary teams capable of addressing a wide range of crop constraints and of supporting research in neighboring countries.

Local nongovernmental organizations
CIAT and its national partners collaborate with various such organizations in disseminating improved seed, establishing groups for small-scale seed production, and developing sustainable cropping systems that include beans.

Bean-Cowpea CRSP, USA
This consortium of US universities offers expertise in biotechnology, among other areas, that can help increase the efficiency of plant breeding.

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Improved Cassava for the Developing World

The Challenge

Of the hundred or so species of the genus *Manihot*, only one has been domesticated. That species, *Manihot esculenta* Crantz, or cassava, provides food and a livelihood for about 500 million people in the developing world.

The crop is relatively tolerant of poor soils and seasonal drought and exhibits an unrivaled ability to recover from damage by pests and diseases. Because it is well suited to harsh conditions, cassava is grown mostly in marginal environments by poor farmers. Used mainly for food in sub-Saharan Africa, the crop's roots also provide a high-quality raw material for processing into livestock feed and industrial starches in Asia and Latin America. Cassava is one of the few crops that offer the possibility of linking small-scale farmers in marginal areas to expanding markets.

Compared to other important staples in the tropics, cassava has been largely neglected in research. Nonetheless, a number of national institutes and two international centers have made a significant commitment to its improvement. To provide inexpensive solutions to major constraints, researchers must develop varieties that are genetically resistant or tolerant to major biotic and abiotic stresses and possess other useful genetic traits, such as high root yield and enhanced root quality.

Objective

To increase and stabilize cassava production in diverse environments by developing improved gene pools in cooperation with national programs

Outputs

- Sources of resistance or tolerance to major pests, diseases, and abiotic stresses
- Sources of desirable root quality characteristics
- Gene pools for the lowland humid, subhumid, semiarid, or highland tropics and subtropics
- Improved breeding methodologies, including farmer participatory approaches
- Networks and trained national personnel for effective dissemination of genetic material

Benefits

New cassava varieties mainly benefit small-scale farmers by securing their food supply and raising their income. Improved germplasm also enables cassava processors to increase their profits and provides urban consumers with cheaper, higher quality products. In Africa and Amazonia, many of these benefits accrue to women, since they are mainly responsible for producing, processing, and marketing the crop.

Strategy

Since cassava is grown in diverse agroecosystems, an important task for international research is to tailor improved germplasm to varied sets of conditions. Key traits are introduced or improved in cassava through a recurrent process of screening, selection, and recombination at representative sites, based on feedback from farmers and colleagues in national programs. Within this strategy, the main tasks of the project are to:

- Establish and maintain pest colonies, develop ways to inoculate and culture pathogens, characterize germplasm for resistance to biotic stresses, and screen it for efficient use of nutrients.

- Alter cyanogen content within gene pools to suit different purposes, develop methods for controlling postharvest deterioration, and genetically modify starch quality.

- Incorporate novel methods of genetic modification, including transformation for interspecific gene transfer, into breeding schemes.

- Evaluate, select, and recombine elite genotypes for specific agroecosystems and incorporate new screening methods and the participation of end users into breeding schemes.

- Gather feedback from the users of improved gene pools, organize training for national programs in Latin America and Asia, strengthen regional networks, and disseminate scientific information.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center has an extensive collection of *Manihot* germplasm and more than two decades of experience worldwide in research on all aspects of cassava.

Various national institutions in developing countries

Brazil's National Center for Research on Cassava and Tropical Fruits (CNPMF), Thailand's Food Crops Research Institute (FCRI), the Colombian Corporation for Agricultural Research (CORPOICA), and other national programs in Latin America and Asia have wide experience in shaping improved cassava genotypes to local needs.

International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

With a regional mandate for cassava research in sub-Saharan Africa, IITA has built a solid record of achievement and extensive contacts with the continent's national programs.

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Tropical Grasses and Legumes for Multiple Uses

The Challenge

In marginal environments of the humid and subhumid tropics, the central challenge of agriculture is to increase productivity and raise living standards, while at the same time halting the degradation of natural resources. Forage grasses and legumes show great potential for helping accomplish both these aims.

Forage legumes provide nutritious feed that can increase the efficiency of livestock production by reducing the need for concentrate supplements in feeds, thus lowering production costs. These species can also contribute to sustainable land management by helping regenerate degraded soils and replenish the nitrogen supply of the production system. In addition, forage plants help reduce erosion and control weeds.

In order to realize the potential of forage grasses and legumes, researchers must accomplish two major tasks. First, they must identify and characterize a wide range of grass-legume combinations that help improve productivity and resource management. And second, they must develop effective approaches for working with national research partners and with farmers to integrate these combinations into specific production systems.

Objective

To identify and promote the use of tropical grasses and legumes in the subhumid and humid tropics, based on characterization of their genetic diversity for traits that make livestock and crop protection more efficient and that contribute to sustainable land management

Outputs

The principal outputs of this project are forage grass and legume species that provide high-quality animal feed, are resistant to major pests and diseases, and are well-adapted to common soil and climatic conditions, such as low soil fertility and drought. These species accomplish a wide variety of purposes, providing stable grass-legume pastures for livestock, supplementing fodder supplies in the dry season, improving fallows and renovating degraded lands, and serving as green manure crops or as soil covers in perennial tree crops.

The project will make outstanding grasses and legumes readily available to research partners, so they can evaluate these species for multiple uses, select them for specific ecological niches, and promote their integration into different production systems.

Benefits

The direct beneficiaries of this work are small-scale farmers in the subhumid and humid tropics, whose livelihoods depend on livestock, annual crops, and combinations of these two with perennial crops. New forages enable these farmers to increase the productivity of their

systems, while maintaining soil fertility, conserving water resources, and preserving the natural vegetation in ecologically fragile areas of the landscape. Greater economic returns to farmers, together with beneficial effects on the environment, offer benefits for rural communities and for society as a whole.

Strategy

The success of this project depends on its partnerships with national institutions and on the active participation of small-scale farmers in the research. Together, researchers and farmers direct their efforts toward three main aims:

- Identify suitable species for stable grass-legume associations with potential for increasing animal production.
- Assess the value of selected grasses and legumes for rehabilitating degraded lands where agriculture is intensive.
- Analyze and disseminate information on the impact of introduced grasses and legumes in different production systems.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

In its gene bank, the Center safeguards over 22,000 accessions from about 155 genera of forage grasses and legumes. It also has many years of experience with interdisciplinary research on promising species.

Tropileche

This is a project in Latin America that forms a part of a global livestock initiative coordinated by the International Livestock Research Institute (ILRI) in Africa. Project participants include universities and national research institutes in Bolivia, Brazil, Colombia, Costa Rica, and Peru.

Southeast Asia Forage and Feed Resources Research and Development Network (SEAFRAD)

Launched in 1995, this network is promoting forage research through collaboration between scientists in Indonesia, Laos, Malaysia, the Philippines, southern China, Thailand, and Vietnam.

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Rice Improvement for Latin America and the Caribbean

The Challenge

Rice is the most important food grain in most of the tropical areas of Latin America and the Caribbean, where it supplies more calories in people's diets than wheat, maize, cassava, or potatoes. Higher, more stable rice yields are a central prerequisite for improving the welfare of the region's urban and rural poor. The national programs with which CIAT works have achieved remarkable progress toward this goal through germplasm improvement. New varieties have increased the efficiency of production, allowing a more competitive rice sector to provide consumers with cheaper rice and producers with better returns.

A major challenge for the region's rice scientists now is to maintain the momentum of crop improvement, while reducing the threat of excessive pesticide use to human health and the environment. Toward this end researchers must further enhance the ability of rice strains to tolerate major biotic and abiotic constraints. This project contributes by generating well-adapted varieties, by providing national programs with better progenitors for crosses, and by facilitating the exchange of information resulting from local and regional trials.

Objective

To increase and stabilize rice yields in the region through germplasm enhancement, emphasizing broad genetic diversity

Outputs

- Sources of tolerance to biotic and abiotic constraints
- Improved breeding populations and cultivars
- Progenitors characterized for major traits of regional interest
- Effective methods for germplasm screening

Benefits

Improved rice varieties enable farmers to produce the crop more efficiently at lower unit costs. In addition to raising producer's profits, these gains make a more abundant rice supply available at lower costs. Cheaper rice primarily benefits the poorest 20 percent of consumers in tropical America, who spend about half their income on food, including 15 percent for rice alone. New rice varieties offer environmental benefits as well, tending to lower pesticide use and reduce the pressure to expand rice production onto new land.

Strategy

The project's strategy consists of the following elements:

- Introduce germplasm from IRRI and other sources, identify progenitors for crossing, and evaluate segregating material.
- Evaluate and recombine gene pools and develop resistance to rice blast, using tools such as recurrent selection.
- Identify useful traits in wild rice germplasm, make interspecific crosses, and select for useful traits, with the aid of molecular markers.
- Characterize a new plant type under direct seeding, improve the supply and uptake of nitrogen for full expression of yield potential, and screen for iron toxicity.
- Obtain new sources of tolerance to major biotic and abiotic stresses through biotechnology and other tools.

In addition, the project coordinates the Fund for Latin American Fund for Irrigated Rice (FLAR) and organizes training.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

CIAT has strong research capacities in conventional plant breeding, biotechnology, and pest and disease management. These are especially important, given the project's emphasis on prebreeding.

Other CGIAR centers

The International Rice Research Institute (IRRI) in the Philippines and West Africa Rice Development Association (WARDA) in Cote d'Ivoire are key players in germplasm improvement and exchange.

Center for International Cooperation in Agricultural Research for Development (CIRAD), France

Within its comprehensive program of agricultural research for the tropics and subtropics, CIRAD contributes importantly to rice breeding and germplasm exchange.

National rice programs

Programs across Latin America have many years of experience in rice breeding work and are strongly committed to this project.

Texas A&M and Cornell University, USA

The former contributes to germplasm exchange, and the latter carries out wild rice crosses.

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Conservation of Plant Genetic Resources in the Neotropics

The Challenge

During recent decades expanding environmental degradation has heightened our awareness of the need for better husbandry of the earth's biological resources. Only by conserving the variability of species can we ensure their continued use for satisfying human needs.

The Leipzig Conference organized by the Food and Agriculture Organization in June 1996 recognized in situ conservation as the preferred method to conserve plant genetic resources for agriculture. The chief advantage of this approach (which is relevant both to the landraces of crops in farmers' fields and to the wild relatives of these crops in natural vegetation) is that it allows evolution to continue testing the adaptation of plant species and shaping their genetic makeup to changing conditions.

In order for in situ conservation to be biologically relevant as well as economically and socially viable, scientists must develop a knowledge base that helps determine what to conserve, how, and where. Ex situ conservation offers many of the answers to these questions by giving farmers, scientists, and other users easy access to the germplasm for study and use. It is vital, therefore, that we begin to integrate these two conservation methods. Two preconditions for this integration are better management of the current ex situ collections and the development of human resources for effective conservation.

Objective

To better preserve the biodiversity of selected crops and their wild relatives in the American tropics by developing the knowledge base and strengthening the institutions needed to integrate ex situ and in situ methods of conservation

Outputs

- Safely conserved germplasm
- Improved techniques for germplasm conservation
- Information from germplasm characterization and evaluation
- Improved availability of information and germplasm to research partners
- Training and other activities that build national capacity for germplasm conservation
- Public awareness activities aimed at strengthening support for the preservation of plant genetic resources

Benefits

This project will benefit farmers throughout the tropics and subtropics by providing them with better access to germplasm accessions (either improved or in their original state) that carry useful traits, such as tolerance to pests and low soil fertility. In addition, universities, crop improvement and other research institutes, nongovernment organizations, and extension

services will profit from first-hand experience with the integration of ex situ and in situ conservation methods.

Strategy

The project's strategy consists of two main elements. First, it works to increase the effectiveness of current facilities and of project partners in conserving tropical species. And second, it brings together specialists in classical germplasm evaluation and molecular genetics to characterize and evaluate ex situ collections, creating the knowledge base required to link these collections with in situ conservation.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center's gene bank safely preserves nearly 1,000 species, including *Phaseolus*, *Manihot*, and important tropical forage grasses (such as *Brachiaria* and *Panicum*) and legumes (e.g., *Arachis*, *Centrosema*, and *Stylosanthes*). This work is carried out by specialists in germplasm conservation, biotechnology, seed physiology, cryoconservation, pathology, and other areas.

International Plant Genetic Resources Institute (IPGRI), Italy

The Institute operates a global program of research and support for the conservation of plant genetic resources.

Crop networks

The Bean Advanced Research Network (BARN), Cassava Biotechnology Network (CBN), and International Network for Evaluating Tropical Pastures (RIEPT) promote biotechnology applications and other steps that facilitate the use of genetic resources for crop improvement.

Gene banks and biodiversity institutes in the developing world

Facilities in Brazil, Costa Rica, Colombia, Mexico, Peru, and other countries are our natural allies in germplasm conservation. The project also has close ties with organizations responsible for research on biological diversity.

Universities, research institutes, and gene banks in the industrialized countries

The project counts on support from many such organizations in a number of areas requiring specialized expertise.

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Enhancing Agrobiodiversity Through Biotechnology

The Challenge

Common bean (*Phaseolus vulgaris*) and cassava (*Manihot esculenta*) are vital to food security and human welfare in many developing countries. Consumption of beans is now highest in eastern Africa, but the crop is also important for poor consumers in the crop's Latin American centers of diversity. Cassava, a cheap source of carbohydrates and an increasingly valuable raw material for industry, is produced almost exclusively by small-scale farmers in marginal environments characterized by poor soils and drought. Sub-Saharan Africa, where cassava provides food for some 200 million people, accounts for nearly half the world's production.

CIAT is engaged in a global effort on genetic improvement of these crops. In support of that work, the Center maintains germplasm collections of beans and cassava as well as their wild relatives. To conserve and use this valuable segment of the world's agrobiodiversity more effectively, we must gain a better understanding of its genetic structure and of its relationship to key features of the environments where beans and cassava originated. Such information can help us determine where to find genetic diversity, what it can be used for, and how it can be used and conserved more efficiently.

In recent years CIAT has made good progress in finding answers to those questions by integrating biotechnology tools with problem-solving research on the Center's mandate crops. Based on that experience, the Center is now well placed to work with national institutions interested in using new techniques to better conserve and use a wide range of agrobiodiversity.

Objective

To promote more efficient conservation and use of agrobiodiversity by developing novel techniques for assessing the genetic diversity of wild and cultivated gene pools, by broadening the crop genetic base, and by collaborating with research partners

Outputs

- Improved strategies for conserving and using genetic resources
- Molecular marker technologies for beans and cassava
- Techniques for assessing genetic diversity in beans and cassava
- Agroecological, agronomic, and genomic information at the intra- and interspecific levels
- Characterization of exotic and novel genes and gene combinations
- Techniques for interspecies gene transfer
- Germplasm containing new gene combinations that broaden the genetic base of crops such as beans, cassava, and rice
- Knowledge about genetic mechanisms of variability and tools for manipulating them
- Training in techniques for assessing genetic diversity and broadening the genetic base

Benefits

The ultimate beneficiaries of this project are farmers and consumers in Latin America and Africa, who need crop varieties containing genetic traits that solve problems in production and processing. Such varieties can help strengthen food security, alleviate poverty, and fuel economic development. The project will also serve scientists in national institutions by making new techniques, information, and genetic stocks widely available to them.

Strategy

The project's strategy consists of the following steps:

- Assess and enhance crop germplasm, using molecular and cellular techniques in combination with other methods and technologies from agricultural research.
- Build research capacities in partner institutions for work on agrobiodiversity and biotechnology.
- Train researchers in new techniques.
- Develop and apply techniques to native agrobiodiversity in collaboration with national institutions in Latin America
- Through biotechnology approaches, gain access to new genetic variability and traits for broadening crop diversity.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center safeguards the world's largest collections of bean and cassava germplasm and offers strong capabilities in biotechnology, germplasm conservation, and crop improvement.

National institutes in Latin America and Africa

The project works with numerous institutes that are responsible for conserving plant genetic diversity and for using it to improve agricultural production.

Alexander von Humboldt Institute of Research on Biological Resources, Colombia

Established recently under Colombia's Ministry of the Environment, this nonprofit institution contributes to the conservation and sustainable use of the country's vast array of biological resources.

Advanced institutions in the industrialized world

The project collaborates with various institutions that are engaged in pathbreaking biotechnology research and are committed to sharing its benefits with developing countries.

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Integrated Pest and Disease Management

The Challenge

In many parts of Latin America, crop losses due to pests (insects, mites, fungi, bacteria, viruses, and weeds) have prompted farmers to overuse pesticides as a means of intensifying crop production. This poses a severe threat to farmers' health and the environment and can make pest problems worse by giving rise to pesticide resistance in insects and by destroying their natural enemies.

The challenge, therefore, is to develop and promote strategies for integrated pest management (IPM), an effective and environmentally sound approach that draws on a combination of control practices.

Objective

To stabilize crop production and reduce the indiscriminate use of pesticides by developing and transferring ecologically sound pest and disease management practices

Outputs

- Quantitative information on the distribution of major pests and diseases and on the damage they cause
- New knowledge on the biology and other aspects of pests and diseases
- Improved techniques, such as molecular methods for characterizing major pathogens
- Components of IPM strategies, including pest and disease resistant germplasm, biological controls, and crop management practices
- Workshops, training, and other services that better enable national programs, nongovernment organizations, and farmer groups to develop IPM strategies
- Impact analysis of IPM projects

Benefits

IPM strategies for marginal environments primarily benefit the families of small-scale farmers by strengthening their food security and raising income through a decrease in losses to pests and diseases and in expenditures on chemical controls. Lower pesticide use reduces a significant threat to the health of farmers and consumers as well as a major source of environmental contamination in agriculture.

Strategy

CIAT's research on pest and disease management focuses on the Center's mandate crops (beans, cassava, tropical forages, and rice) and agroecosystems (forest margins, hillsides, and savannas). In recent years this work has expanded beyond its traditional role of supporting the development of host plant resistance to include biological and cultural control practices and IPM.

Our IPM strategy consists of four phases: 1) problem definition, 2) research, 3) pilot study, and 4) implementation. Through diagnostic surveys, we determine the nature of pest and disease problems and farmers' perceptions of them. For the pests that cause the greatest damage, we conduct research to develop effective control measures. Using participatory research methods, we then carry out pilot studies to determine which control strategies farmers can adopt most readily. Scientists at CIAT and in local and national organizations work as partners with farmers to develop efficient IPM strategies.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center has scientists working in entomology, pathology, virology, and weed science, in addition to expertise in related disciplines, especially in crop management and the social sciences. CIAT also has strong capacities in farmer participatory research methods and geographical information systems, which are vital for effective integrated pest management projects.

Other international institutions

The project draws on the research capacities of the Center for Research and Training in Tropical Agriculture (CATIE), France's Center for International Cooperation in Agricultural Research for Development (CIRAD) and the French Institute of Scientific Research for Development and Cooperation (ORSTOM), the International Centre of Insect Physiology and Ecology (ICIPE), and the International Institute of Tropical Agriculture (IITA).

National institutes in developing countries

The Colombian Corporation for Agricultural Research (CORPOICA), Brazilian Agricultural Research Enterprise (EMBRAPA), Ecuador's National Institute for Agricultural Research (INIAP), and Uganda's National Agricultural Research Organization (NARO) are among the project's major collaborators in the development of IPM strategies for specific environments.

Advanced institutions in developed countries

The Natural Resources Institute (NRI) in the UK, the universities of Florida and Wisconsin in the USA, and the John Innes Institute in Scotland supply valuable technical expertise.

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Sustainable Systems for Small-Scale Farmers

The Challenge

In addition to producing enough food for themselves and their families, small-scale farmers in the tropics actively seek new and reliable sources of cash income to provide life's other necessities and to educate their children. Though anxious to increase the productivity and profitability of their farms, these people face many obstacles to that goal, such as declining soil fertility, reduced availability of water, and a lack of control over important decisions that directly affect their welfare.

Technologies consisting of improved crop varieties together with crop and resource management practices have shown potential for substantially increasing farm incomes, while contributing to the sustainability of farming systems. But for several reasons these technologies have not been widely adopted. Sometimes they are simply not suited to farmers' circumstances. In many cases farmers cannot afford purchased inputs (such as fertilizer or pesticides), have no market for increased production, or are unaware of new possibilities.

An important challenge is to bring farmers' perspectives and skills more fully to bear on research for improved crop production and soil management. To accomplish this requires that the traditional supply-driven culture of agricultural research and extension be replaced by a new approach that involves farmers and local communities in setting research priorities, developing improved technologies, and evaluating their impact. This in turn requires that we pursue new modes of collaborative research with a wide range of government and nongovernment organizations.

Objective

To develop technologies for crop and livestock production and sustainable crop and resource management in those parts of Latin America, Asia, and Africa where beans, cassava, and forages figure importantly in small-scale farming systems

Outputs

- Information that permits better targeting of appropriate technology development
- Technologies and management options that can readily be integrated into small-scale farming systems to make them more productive and sustainable
- Strategies for improving the ability of cooperating institutions to conduct farmer participatory research and promote the adoption of sustainable land use practices
- Information on the impact of new technologies and strategies

Benefits

The project primarily benefits low-income farmers through technology that enables them to strengthen food security, raise incomes, and protect the natural resource base. Wider adoption of environmentally sound farming practices also benefits society as a whole.

Strategy

The project builds on previous work with beans, cassava, forages, and rice, much of it featuring a farmer participatory approach. Current efforts are aimed at developing or strengthening adaptive research at sites in the forest margins of Peru and Colombia, in hillside agroecosystems of Central America, in upland environments of Southeast Asia, and in bean-based systems of eastern and southern Africa. Specifically, the project:

- Identifies farmers' constraints, opportunities, and objectives through participatory diagnosis
- Analyzes this information together with secondary data to identify innovations that may be attractive to farmers and should enable them to use their resources more efficiently
- Applies farmer participatory methodologies to develop, adapt, and evaluate new technologies
- Devises strategies for disseminating research results from reference sites to other areas
- Measures the socioeconomic and environmental impact of new technologies

The research is conducted by teams at ecoregional benchmark sites and by specific projects, such as Tropileche in Latin America and Forages for Smallholders in Southeast Asia.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center offers expertise in research on crop improvement and agronomy, on livestock production, on farmer participatory methods, and on soil and watershed management.

Organizations in developing countries

The project works with numerous government and nongovernment organizations in Latin America (Colombia, Costa Rica, Honduras, Nicaragua, and Peru), Southeast Asia (Indonesia, Laos, Philippines, Thailand, and Vietnam), and eastern Africa (Ethiopia, Rwanda, Tanzania, and Uganda).

Other advanced institutions

The International Livestock Research Institute (ILRI) in Ethiopia, International Centre for Research in Agroforestry (ICRAF) in Kenya, Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the Oxford Forestry Institute (OFI) in the UK provide valuable expertise in research on crop and resource management.

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Improving Soil Quality in Marginal Environments

The Challenge

Across much of Africa, Latin America, and Asia, inherently poor soils and soil degradation keep small-scale farming essentially stagnant. Infertile acid soils are especially common. In many places, even fertile soils have been damaged so badly that they no longer respond adequately to fertilizer application. Farmers' best hope for achieving lasting gains in agricultural productivity lies in mixed cropping systems that combine more productive germplasm with innovative practices for better managing the soil and water.

Because soil and other conditions may vary greatly from one place to another, improved systems must be carefully tailored to specific environments. International research can speed this process by explaining the basic principles of the chemical, physical, and biological processes that determine soil quality. Based on such information, researchers can better determine whether a given system will remain productive over time and whether it can be successfully transferred to other areas within an agroecosystem or even to another agroecosystem. In order to manage such systems effectively, small-scale farmers need simple but reliable indicators of soil quality that enable them to monitor the impact of new systems on soil quality. On this basis they can then make timely adjustments to maintain natural soil fertility over the long term.

Objective

To promote more efficient and sustainable use of soil, water, and nutrients in crop-livestock systems by providing a better understanding of the principles underlying practices that protect and improve the quality of tropical soils

Outputs

- Guidelines for selecting more productive and efficient combinations of crops and forages
- Principles for better managing nutrients, crop residues, and green manures; for controlling erosion; and for improving soil structure
- Diagnostic kits consisting of methods and indicators that help farmers and extension officers assess soil health and make decisions about resource management
- A decision-support system, based on simulation models, for enhancing agricultural productivity and and conserving natural resources
- Strategies that better enable government and nongovernment organizations address issues in soil, water, and nutrient management

Benefits

This project primarily benefits small-scale crop and livestock producers by offering them better ways to strengthen local food security, raise incomes, and ensure the long-term productive capacity of the land. The research is especially relevant to farmers occupying infertile acid soils in tropical hillsides, forest margins, and savannas. Widespread adoption of improved resource

management practices also benefits society at large by creating a more reliable supply of food, by fueling economic growth outside agriculture, and by preserving the natural resource base.

Strategy

Working in a coordinated fashion across representative research sites, the partners in this project carry out soils research to better understand key biological, chemical, and physical mechanisms in soil processes. Through this research they develop conceptual models of soil-plant systems that make it possible to predict the performance of these systems under variable conditions over time and space. The project also examines the soil productivity and quality effects of integrating multipurpose legumes, crops, and animals. In addition, the project develops simple soil quality indicators for small-scale farmers.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia
The Center has considerable experience in research on acid soils in Latin America.

Other international institutions
France's Center for International Cooperation in Agricultural Research for Development (CIRAD) and the French Institute of Scientific Research for Development and Cooperation (ORSTOM) have an extensive history of contributing to rural development through research. The International Fertilizer Development Center (IFDC) in the USA has worked closely with CIAT in research on the nature of soils and their improvement.

Universities in developing countries
The National University of Colombia, the University of Cauca in Colombia, and the University of Uberlândia in Brazil collaborate actively with CIAT in soils research.

Universities in developed countries
The University of Paris in France, the University of Bayreuth in Germany, the University of Complutense in Spain, and the Cornell, Ohio State, and Florida State Universities in the USA all have specialized capacities and a strong interest in research on tropical soils.

National agricultural research institutions
The Colombian Corporation for Agricultural Research (CORPOICA), the National Federation of Colombian Coffee Growers (FEDECAFE), the Brazilian Agricultural Research Enterprise (EMBRAPA), and the various members of two research consortia in the Andean zone are all active in developing sustainable production systems for marginal environments.

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Rural Agroenterprises for Small-Scale Farmers

The Challenge

Many farmers in the developing world have few alternatives but to pursue unsustainable production systems, such as slash-and-burn and cultivation on steep hillsides.

Much previous research has centered on the development of sustainable production systems and on the conservation of natural resources. But little attention has been given to identifying market opportunities that would make it economically feasible for smallholders to adopt sustainable alternatives.

The tropical world is rich in raw materials that have potential demand in local and international markets. Changing market trends and consumption habits are creating niches for exotic fruits, nuts, medicinal plants, and organic raw materials, such as essential oils, natural colors, spices, and tannins. New opportunities have also arisen for traditional commodities (involving new products from cassava, sugarcane, and livestock) and for local seed production.

But smallholders and small-scale entrepreneurs face numerous barriers that prevent them from taking full advantage of these market opportunities. They generally have little business experience and lack information about technologies, markets, and prices. Moreover, rural areas offer few support services (such as credit, transportation, and communication) for commercial activities.

Objective

To help link smallholders in developing countries to local and international growth markets by establishing and strengthening rural enterprises and complementary support services

Outputs

- Participatory methods for identifying and screening market opportunities
- Decision-making models for establishing and strengthening rural enterprises
- Recommendations for the design of appropriate support services for rural enterprises
- Information and advice on new and traditional technologies for postharvest handling and processing
- Enhanced capacity within national institutions to promote agroenterprises

Benefits

This project will strengthen the capacity of government and nongovernment organizations to establish viable, small-scale agroindustrial enterprises. Rural people, especially women farmers, middlemen, and entrepreneurs, will profit from training, information on market opportunities, improved postharvest processing technologies, and better support services. Both

these groups and urban populations will benefit through improved consumer products and better protection of natural resources.

Strategy

The partners in this project build on previous success in establishing cassava and other agroindustries in rural Latin America. Through an integrated approach, the project:

- Designs and executes pilot projects for rural agroindustrial development in representative areas of the hillsides and tropical lowlands
- Analyzes and disseminates information on agroindustrial development experiences.
- Collaborates with NGOs active in promoting small agrobusinesses

These activities are tied to other projects for research on natural resource management.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center has various projects that collaborate with local consortia focusing on sustainable resource management and rural development. CIAT's Cassava, Rice, Bean, and Forages projects and its Information and Documentation Unit are also closely involved.

Program for Rural Agroindustrial Development (PRODAR)

This Program has coordinated the support of rural agroindustry by international and national agencies since 1989. It operates through national networks of government and nongovernment organizations (REDARs) in 18 Latin American countries.

Center for International Cooperation in Agricultural Research for Development (CIRAD), France

The Center provides expertise in processing, in the development of food products, and in support for small-scale enterprises.

International Development Research Centre (IDRC) in Canada

IDRC has set up the FoodLink Initiative, through which technical and marketing advice will be sought from Canadian food enterprises and trading organizations.

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Community Management of Natural Resources in Hillside Watersheds

The Challenge

The hillsides agroecosystem of tropical America covers about 1 million square kilometers and sustains an estimated 10 million poor people in marginalized, rural communities. More than half of this area is undergoing rapid environmental degradation, as a consequence of deforestation, overgrazing, and destructive agricultural practices. The sense of hopelessness that prevails in many hillside communities is fed by deteriorating markets for agricultural produce, a lack of political power, increasing pollution of water supplies, dwindling employment opportunities, and rampant emigration.

The economic and environmental problems these communities face often transcend the level of individual farms and must be addressed through collective action across entire watersheds. Such action requires that rural communities be able to set clear objectives; quantify the various economic, social, and environmental factors that enter into their decisions; and define with some precision the geographical area of interest. This latter task is essential for accurately identifying problems, measuring progress toward solutions, and reproducing favorable results in other places.

To make effective use of this information, hillside communities need organizational models that enable them to reconcile conflicting interests in natural resource management. This can take place through a process of "deal making," in which the social costs of resource conservation are balanced by concrete social incentives. These come in the form of new economic opportunities brought within the community's reach by consortia of local government and nongovernment institutions.

Objective

To improve community management of watershed resources and to encourage the adoption of technological innovations by developing systems that facilitate decisions about crop, livestock, and other production enterprises and by devising organizational models that ensure broad community participation in natural resource management

Outputs

- Procedures for prioritizing areas, problems, and social groups in hillside communities
- Methods for including the perspectives of different segments of hillside communities in proposed changes in resource management
- Guidelines for defining the smallest quantity of data needed to support decision making about resource management
- Methods for organizing collective action in hillside communities
- Interactive decision-support tools and models for using these in participatory planning

Benefits

The direct beneficiaries of this project are low-income farm families and the wider communities of the Andean and Central American hillsides, all of whom can profit from new economic opportunities and better husbandry of soil and water. Such improvements also favor areas outside hillside communities that depend on their water and other resources and have economic ties with them. Tools and methods developed by the project will increase the effectiveness of national and international development organizations.

Strategy

The project's efforts are channeled along two parallel lines. First, we work to increase the precision of data and make it available in convenient forms, so that local communities can analyze land use change accurately. In a related task we develop methods for field monitoring and linking of indicators for soil and water, for production system performance, and for environmental sustainability. We also assess the likely outcomes of new and current practices, including their off-site consequences. New methods and tools are tested with hillside communities, and local knowledge is used to refine decision support systems. The second line of research is aimed at developing replicable models for establishing the institutional support and training capacities needed to encourage the use of new decision support systems in community watershed management.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

In recent years the Center has made a sizable commitment to research in hillsides.

Other international centers

Five centers conduct research on different aspects of resource management in hillsides.

National organizations in Colombia, Honduras, and Nicaragua

Government and nongovernment organizations, some belonging to hillsides consortia and other local or regional networks offer a wide range of research capacities, services, and information

Developed country universities

The Universities of Florida (USA), Wageningen (Netherlands), Berne (Switzerland), Guelph (Canada), and Edinburgh (Scotland) provide expertise that is vital for developing appropriate computer tools to support decision making.

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Land Use and its Environmental Impact

The Challenge

Tropical America encompasses vast and rapidly changing agricultural frontiers. Current patterns of land use are believed to be the greatest source of environmental degradation in the region. The principal problems are soil erosion, deforestation, and the irreversible loss of biodiversity that is valuable for local communities, the region, and the entire world.

Though often a source of destruction, land use also holds the key for combating the very conditions of rural poverty that help perpetuate the loss of natural resources. The region's agricultural frontiers hold many untapped opportunities to achieve sustainable production of food and fiber without environmental degradation.

In order to identify these opportunities and design effective policies, strategies, and technologies for taking advantage of them, decision makers at all levels need information about the dynamics of land use. Since this involves complex interactions between numerous environmental and socioeconomic factors, a major challenge is to provide the information in forms that decision makers can easily understand and use.

Objective

To promote better policies and decisions about land use by analyzing land use patterns and policy alternatives in a variety of situations, by generating indicators of sustainable land use, and by identifying environmental opportunities and constraints

Outputs

- Assessment of opportunities and constraints in sustainable land use
- Characterization and classification of land use patterns and their spatial distribution
- Information on the determinants, dynamics, and impacts of land use
- Environmental and sustainability indicators that are relevant to land-use policy

Benefits

More appropriate land-use policies and strategies will improve the living conditions of the rural poor and benefit all of society by contributing to environmental sustainability. The immediate recipients of products from this project fall into two groups. One includes policy makers at the international, national, and local levels; development and planning agencies; and nongovernment organizations. The second group includes institutions engaged in the development of agricultural technology.

Strategy

The project's strategy consists of the following tasks:

- Diagnose the ecological health of major agroecosystems, conduct field characterization of study sites, and assess alternatives for the restoration of degraded lands.
- Characterize and map land use patterns in hillsides, forest margins, and savannas; develop digital maps of land use, environmental degradation, and poverty; and make quantitative analyses of potentially sustainable land uses.
- Develop explanatory simulation models of land use dynamics by analyzing historical changes in land use and identifying the key determinants of farmers' decisions within a holistic framework.
- Define sets of indicators for environmental sustainability at different scales, test selected agroecosystem indicators in the field, organize a network of regional and national institutions that develop or need indicators, and through this network devise a conceptual framework within which to use indicators.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

In recent years the Center has greatly expanded its land use databases and its capacity to analyze this information.

World development organizations

The United Nations Environment Programme (UNEP), the UN Commission on Sustainable Development, the Economic Commission for Latin America and the Caribbean (ECLAC), and the International Union for the Conservation of Nature all have wide experience in the development of environmental and sustainability indicators. The World Resources Institute and World Conservation Monitoring Centre also have considerable expertise.

Government agencies and universities

There is a growing emphasis on environmental issues within institutions such as the Brazilian Agricultural Research Enterprise (EMBRAPA), the Colombian Corporation for Agricultural Research (CORPOICA), Argentina's National Institute for Agricultural Technology (INTA), and the National Fund for Agricultural Research (FONAIAP) in Venezuela, together with ministries of agriculture and the environment and numerous developing country universities.

Other CGIAR centers

The International Potato Center (CIP) in Peru, the International Wheat and Maize Improvement Center (CIMMYT) in Mexico, the International Centre for Research in Agroforestry (ICRAF) in Kenya, the International Food Policy Research Institute (IFPRI) in the USA, and the Inter-American Institute for Cooperation in Agriculture (IICA) in Costa Rica work on important aspects of environmental sustainability.

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Methods of Farmer Participation and Gender Analysis

The Challenge

The participation of farmers, especially women, in the development of agricultural technology is vital for achieving impact that benefits the poor. For that reason several international centers have done substantial work over the last decade or so to introduce the farmers' perspective into downstream adaptive research.

This project builds upon that work but offers something more. Recent evidence suggests that farmer participation can be critical in the *upstream* stages of certain types of research. In contrast to earlier approaches to on-farm research, upstream participatory research and development brings users into the early stages of technology development to help set priorities, define criteria for success, and determine when an innovation is ready for release to farmers.

To realize the potential of this approach requires considerable methodology development, involving rigorous empirical research on new techniques integrated with strategic and applied research for technology development.

Objective

To increase the adoption and adaptation of improved agricultural technology by developing, applying, and disseminating participatory methods and principles of organizational design that improve feedback from users to scientists at early stages in research

Outputs

- Methods for participatory plant breeding and research on natural resource management
- Widely applicable, gender-sensitive methods suitable for upstream participatory research

Benefits

Poor farmers, especially women, will obtain more appropriate technology by having regular input into its development. International centers, national research institutes, nongovernment organizations, and rural grassroots organizations will be able to work more effectively with technology users. As a result, they will develop and deliver appropriate technologies for small-scale farmers more cost-effectively.

Strategy

The project's efforts are of two main types. The first involves the integration of empirical field studies for methodology development into other CIAT projects addressing a wide range of challenges in crop production and natural resource management. The second consists of

training, workshops, and other activities designed to refine new methods and disseminate them among other international centers, national research institutions, and producer organizations.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

The Center has been developing farmer participatory research methods and integrating them into specific projects for the last 10 years or more.

Other CGIAR centers

Various centers belonging to the CGIAR Systemwide Initiative on Farmer Participatory Research and Gender Analysis for Technology Development contribute importantly to the project.

National research and development institutions

Various national research institutes, universities, and nongovernment organizations collaborate in training at the regional level through consortia or networks such as the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) and the Cooperative Project for Agricultural Research and Technnology Transfer in the Andean Region (PROCIANDINO).

Developed country universities

Cornell University in the USA and the University of Guelph in Canada take part in training at the national level.

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Partnerships for Agricultural Research and Development

The Challenge

A number of recent developments on the world scene have altered the relations between national and international organizations dealing with agriculture. Whereas previously their joint efforts focused mainly on increasing the productivity of a few staple crops, they are now expected to contribute as well to alleviating rural poverty, improving the management of agriculture's natural resource base, and making the farm sector more competitive and dynamic in market economies.

The need to deal with more complex challenges through a broader research agenda has brought many additional actors onto the agricultural scene, including national research institutes, universities, nongovernment organizations, and the private sector. A central challenge for these institutions is to find new ways to reach out to one another and to work with the international centers.

Objective

To help increase the effectiveness of national, regional, and global agricultural research and development systems by building partnerships, sharing information, developing human resources, and promoting collaboration between countries and institutions

Outputs

- Local and regional consortia and networks that integrate the research and development activities of public and private sector organizations related to selected crops and agroecosystems
- Global networks for sharing information, prioritizing research, and promoting collaboration
- Training for staff of national research and development organizations
- Regional projects developed in cooperation with national organizations

Benefits

Through information sharing, exchange of results and experience, and joint priority setting, the project contributes to more effective use of the human and financial resources dedicated to agricultural research and development. These gains, in turn, benefit producers, processors, and consumers by improving their access to new knowledge, technologies, methods, and other tools emerging from research.

Strategy

The project's strategy consists of three main components. First, we engage in permanent consultation with partner institutions to ensure that research cooperation is firmly based on the priorities of particular countries and regions. Second, the project continually monitors the overall environment of agricultural institutions in those countries and regions, so that cooperative arrangements can be modified accordingly. And third, we carry out cooperative activities at various levels, from global and regional forums to individual research projects.

Project Partners

International Center for Tropical Agriculture (CIAT), Cali, Colombia

In the 30 years since its founding, CIAT has built an extensive network of contacts with other international centers and with numerous national research and development organizations.

Public and private sector institutions for national agricultural research and development

This group encompasses a wide range of national organizations (in developing and developed countries) working on themes related to CIAT's research mandates in crop improvement and natural resource management.

Regional organizations for agricultural research and development

Various regional organizations in Latin America and other regions provide an effective means for joint priority setting and planning, for sharing research results, and for organizing activities aimed at strengthening agricultural institutions.

Other international agricultural research centers

CIAT has a long history of working closely with other centers, facilitating their activities in Latin America and providing important inputs into their work on other continents, especially Africa.

Donors of agricultural research and development

Even though donor support has eroded in recent years, a long list of countries and organizations remain firmly committed to agricultural research as a means of attacking poverty and addressing environmental issues.

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The Impact of Agricultural Research

The Challenge

The financial resources available to international agricultural research have diminished rapidly in recent years, at the same time that the research agenda has broadened considerably. To satisfy the growing demands on their institutions, planners must therefore ensure that scarce resources are being used as efficiently as possible. For this purpose they need reliable information about the impact of research.

Much previous work has examined the effects of commodity research on productivity. Less is known about the economic benefits of research on natural resource management, of conserving biodiversity, of policy and institutional research, and of collaboration between international and national organizations.

There is thus ample scope for improving our ability to estimate the probable magnitude and distribution of benefits from a wide range of research and related endeavors. It is particularly important that we appraise more accurately the likely consequences of research for specific groups of beneficiaries, such as low-income farmers and specifically women. To carry out such analyses, institutions urgently need better information and methods that can be applied at the regional, national, and agroecosystem levels. In determining the acceptability, adoption, and impact of selected outputs from CIAT's research, the Center can at the same time develop tools and databases that are suitable for wider use in national institutions.

Objective

To help guide resource allocation at CIAT, improve the quality and efficiency of the Center's work, better inform stakeholders about the returns on their investments, and assist national institutions in setting priorities by generating impact information and impact assessment methods

Outputs

- Databases, methods, and guidelines that both international and national institutions can employ to assess the economic benefits of research on commodities and natural resource management
- Estimates of the expected contribution of CIAT's outputs to economic growth, the alleviation of poverty, and to the sustainability of natural resources
- Analysis of the acceptability, adoption, and impact of outputs from the Center's research
- A system for conducting, monitoring, and evaluating projects, designed to be an integral component of projects at CIAT

Benefits

This project will benefit research planners in national institutions and in the Consultative Group on International Agricultural Research (CGIAR) by providing information that facilitates decisions about the allocation of research resources. Improved resource allocation could increase the rate of return on investment in agricultural research by an estimated 2 percent. Research stakeholders will profit from an improved ability to measure the expected returns on investment in agricultural research.

Strategy

The project's strategy consists of four main steps:

- Compile data sets on research activities and costs, biophysical conditions, production systems, commodity markets, demography, and infrastructure; review existing aggregate models; and adapt novel techniques to include nonmarket outputs in the economic analysis
- Analyze current development trends and formulate research investment scenarios to estimate the magnitude and pattern of expected benefits from CIAT's outputs
- Review the adoption history and impact of CIAT's outputs.
- Develop procedures to monitor and evaluate projects, help project managers apply them, and use the resulting information to improve impact projections.

Project Partners

International Center for Tropical Agriculture, Cali, Colombia

The Center has significant experience, information, and economics expertise for assessing research impact.

Other international research centers

The project benefits from close collaboration with the International Food Policy Research Institute (IFPRI).

National research institutes in Latin America, Asia, and Africa

These institutions contribute importantly to field studies on the acceptability and adoption of new technologies. Projects are underway with the National Center for Research on Cassava and Tropical Fruits (CNPMF) in Brazil and with Peru's National Institute for Agricultural Research (INIAP).

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