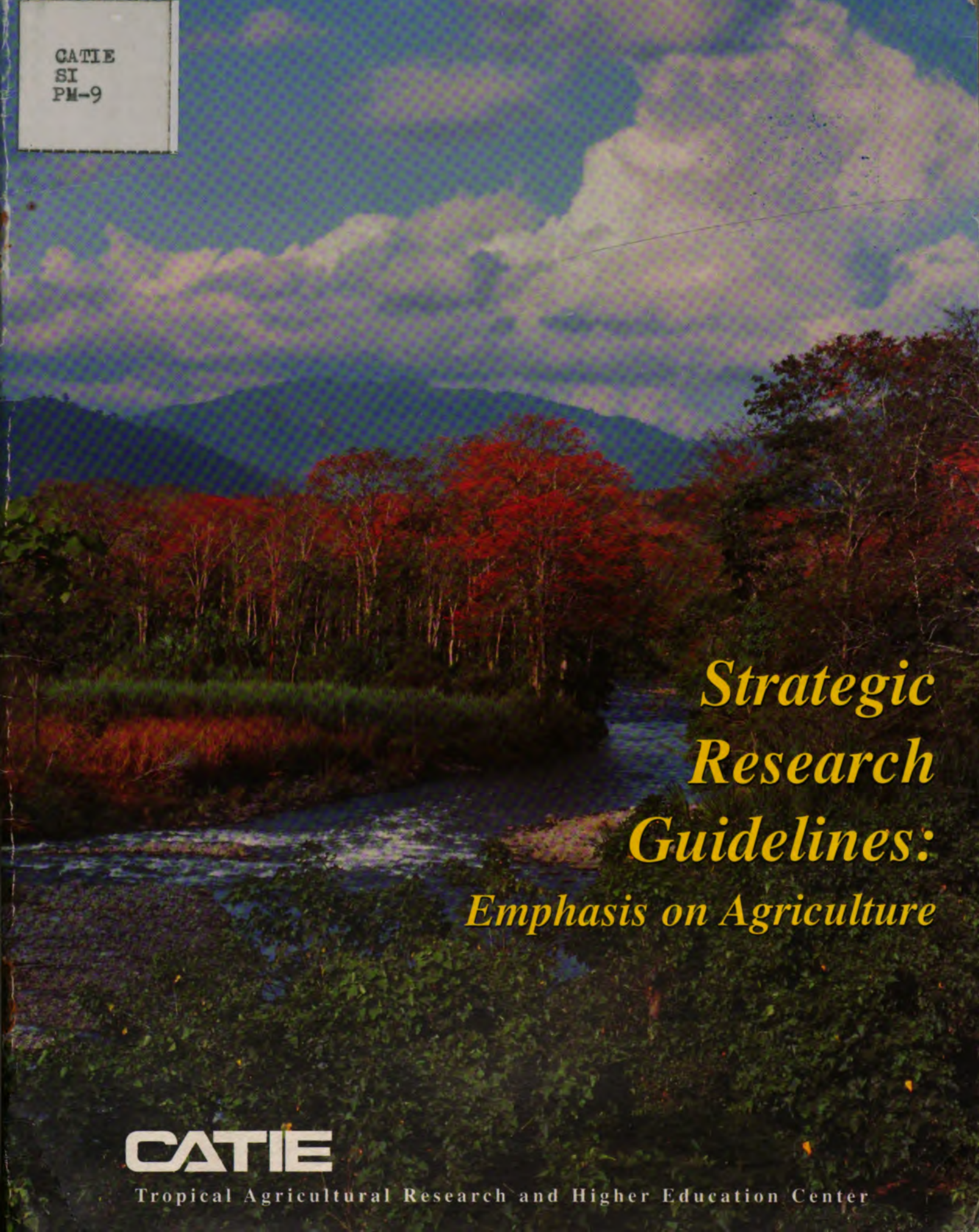


Strategic Research Guidelines:

Emphasis on Agriculture

CATIE

Tropical Agricultural Research and Higher Education Center

Institutional Series. Miscellaneous publication N° 9

Strategic Research Guidelines:

Emphasis on Agriculture

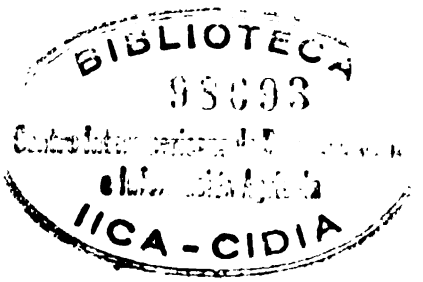
Tropical Agricultural Research and Higher Education Center

Turrialba, Costa Rica

1999

CATIE's Mission

To improve the well-being of humankind by applying scientific research and higher education to the development, conservation and sustainable use of natural resources in the American Tropics.



630.72
T856 Tropical Agricultural Research and Higher Education Center
Strategic Research Guidelines:
Emphasis on Agriculture /
Tropical Agricultural Research and Higher Education Center – Turrialba, C.R. : CATIE, 1999.
20 p. ; 23 cm. – (Institucional series. Miscellaneous publications ; no. 9)

ISBN 9977-57-323-9

1. Investigación agrícola 2. Sostenibilidad 3. Instituciones de investigación I. Título II. Serie

This document contains information presented to the Board of Directors in April 1998.

Contents

INTRODUCTION

With the current advances of globalization, the member countries of CATIE are seeking to protect natural resources and fulfil the priorities of agricultural production. This has led CATIE's Board of Directors to implement an agricultural research plan designed in accordance with the resources, competitive advantages and requirements of the region. It fosters the development of strategies in the fields of biotechnology, plant protection and the conservation of genetic resources in agroforestry systems, and emphasizes the importance of activites connected to the molecular characterization of genetic materials and the identification and biological control of pests. The plan will be implemented over the next decade and an agricultural research strategy that stands in alliance with nature will be put into practice. The fundamentals of this plan are described below.

THE GREAT CHALLENGES OF THE NEXT MILLENNIUM

According to the World Bank, despite the accelerating process of urbanization, almost three quarters of the world's population will live in rural areas in the first decades of the twenty-first century. Furthermore, some 33 million rural inhabitants in CATIE member countries currently live in poverty (ECLAC), and approximately 800 million people are affected by malnutrition.

United Nations' estimates suggest that the world population will exceed 8 billion in the year 2025, an increase of 2.5 billion over a 30-year period. The greatest challenge for the world is on a political and scientific-technological level. The technological challenge will be to develop new production systems that bring high productivity into harmony with environmental sustainability. While private enterprise has an important role in this process, there are areas of scientific-technological development that are of little interest to the private sector, including, among others, the management of natural resources and low input agriculture.

The Latin American and Caribbean region is characterized by an enormous diversity of situations, countries, cultures, conditions and systems of agricultural production. Because most of the rural poor are hired laborers or subsistence farmers settled in ecologically fragile agricultural frontier areas, rural poverty is associated with the issue of sustainability of the natural resource base. At the same time, some commercial producers are employing new concepts and methods such as biotechnology and soil conservation practices. According to the World Bank, the three challenges for the region are: the reduction of poverty, improved utilization of the productive capacity, and sustainable management of natural resources.

The recent summit of 34 heads of state of our hemisphere gave high priority to education as an indispensable training instrument for society's most valuable resource.

A quick glimpse of an image of the next millennium reveals a society of contrasts, challenges and opportunities, where a striking difference is evident between the developed and developing worlds in terms of investments to generate scientific and technological intellectual resources.

The United States produces almost 4,000 graduates in the areas of science and technology per million inhabitants, while in the South this index scarcely reaches 200 per million. The significant difference of 20 to 1 is telling witness to current and prevailing conditions.

The uncontrollable force with which resources and renewable and non-renewable natural reserves are being deteriorated is noted with concern and powerlessness.

The alarming figure of 25 million hectares deforested annually (8 million in Latin America), the steady deterioration of the agroecological mantle, continuing desertification, the erosion of biodiversity and climatic changes, among others, are unquestionable realities.

These signs are sufficiently convincing for a new generation of scientists, academics and specialists to devote their physical and mental efforts to designing policies and strategies for technological and human resource development, with a view to entering the third millennium with renewed hope and a genuine desire to close gaps in knowledge, contribute to social equity and attain a favorable position in the globalized world.

FRAME OF REFERENCE FOR RESEARCH WITH AN EMPHASIS ON AGRICULTURE

CATIE's mandate establishes that its mission is "to foster and promote research and teaching in agricultural and related sciences, designed for the development, conservation and sustainable use of natural resources of the American tropics, in order to improve the welfare of humanity." In its document **Agenda for a Critical Decade, Strategy Plan 1993-2002**, an analysis is made of the challenges that the region faces as a consequence of the globalization of the world economy, the structural adjustments undertaken by countries, the steadily increasing population, the increase of rural poverty, and the deterioration of water and soil resources.

In accordance with its mission and objectives and the analysis of regional conditions set out in the aforementioned document, the Center has established as a priority for this decade: "The sustainable development of agriculture and conservation of natural resources in fragile ecosystems, particularly those involving the production systems of small and medium producers in the American tropics."

The greatest problem related to the sustainablity of renewable natural resources is their use and inadequate management. As stated by the Bruntland Commission: "Sustainable agriculture should include the successful management of crops and forestry to satisfy changing human needs, and at the same time conserve or improve the quality of the environment and natural resources."

The most important problems in the region concerning the productive agricultural sector and natural resources, as identified in CATIE's member countries and more or less common to other countries, are:

- Reduction in available land suitable for agriculture
- Use of fragile areas for food production
- Lack of integration of production systems in the prevailing cultural, social, economic and ecological setting
- Low inputs for primary agricultural activities
- Few alternatives to the use of agrochemicals
- Limited development of technology in the tropics for the integrated management of biophysical resources.

CATIE has an up-to-date Institutional Development Plan implemented through Annual Operation Plans, which define the strategies and activities leading toward institutional goals.

The research program has a renewed plan that consists of five lines of action with corresponding sub-lines, which was approved by the CATIE Board of Directors in 1997.

The Center, with the support from its highest governing bodies and donor and cooperating entities, has developed competitive advantages and is recognized internationally for its:

- leadership in integrated pest management, biological control, biotechnology and agroforestry,
- regional and worldwide prestige for its research and teaching activities on sustainable tropical agriculture,
- physical presence in the Central American area, Mexico and part of South America and the Caribbean,
- consolidated core budget that has allowed it to formulate longer-term plans with greater autonomy and to integrate its programming and operational activities, and
- a collection of more than 12,000 accessions of crops of major importance such as coffee, cocoa, peach palm, tropical fruits and vegetables, and other germ plasm of high value.

At the same time, however, there are restrictions that limit the development of CATIE's scientific and technological activities in the region, such as insufficient financial resources; the weakness of some agricultural research activities such as soil and water management, and plant physiology; the focus of projects is determined by the source of funding; and insufficient research capacity to adequately serve regional demands.

The Academic Scientific Committee of the CATIE Board of Directors, at its Eleventh Regular Meeting of 1997, recommended that the Board of Directors approve a directed framework of research that introduces priority activities in the areas of conservation and improvement of genetic resources, integrated pest management and biological control. To this end, present activities were reviewed, taking into account the need to integrate initiatives in order to ensure

harmonization and complementarity among the scientific activities carried out by the institution. In order to accomplish this, research projects were restructured.

The present document was approved by the CATIE Board of Directors at its Fourteenth Regular Meeting, in 1998.

RESEARCH GOALS OF THE AGRICULTURAL COMPONENT

CATIE's main research objectives in the coming decades are the following:

- Sustainable production of tropical crops
- Environmental protection
- Food security
- Rural poverty

Sustainable production of tropical crops

The structure of consumption by selected countries (Table 1) and the costs of some staple products between 1980-1995 (Table 2) suggests the market potential for food and beverage products. Price instability must also be considered.

Table 1 characterizes the structure of consumption of countries according to their revenues. It shows that, as a country becomes more developed, its expenditures orient more towards the consumption of manufactured goods and services and less toward the consumption of primary agricultural products, revealing a preference for greater diversity in consumption.

Most developed countries have highly efficient technology for the production of foods. They are self-sufficient in staple foods, except for some fats and oils, tropical fruits and drinks, and for which an increase in consumption is envisaged worldwide. Other developed nations such as Japan, Spain and Ireland, as well as middle-income countries including Argentina, Brazil and Chile, still commit an important part of their revenues to food consumption. These countries are considering the possibilities of developing the market for tropical agricultural products.

Table 1. Consumption for selected countries; percentage segments of total domestic consumption (1980-1985).

Countries by revenue	Food	Clothes and shoes	Medical services	Education	Transport and communication	Fuels and energy	Other goods
United States	10	6	14	8	14	18	30
Japan	17	6	10	7	9	17	34
Germany	12	7	13	6	13	18	31
Chile	29	8	5	6	11	13	29
Venezuela	23	7	8	5	11	10	36
Brazil	35	10	6	5	8	11	27
Indonesia	48	7	2	4	4	13	22
Honduras	39	9	8	5	3	21	15
Kenya	38	7	3	10	8	12	22

Source: World Bank

FAO estimates show that, in the last decade, while there was a global loss in purchasing power for agricultural products of 25%, the loss was 38% for the products of developing countries. Prices could continue to fall throughout the 1990s. The International Food Policy Research Institute (IFPRI) believes prices will vary between 12 and 25 percent. The items most affected by falling prices have been tropical products (coffee, cocoa, sugar and oils); cereal and meat prices fell the least (Table 2).

Table 2. Prices of some staple products in US $ (1980-1995).

Product	1980	1985	1980	1985	1995/1980	1995/1990
Sugar	45	5	13	12	-73%	-7%
Banana	30	22	30	18	-40%	-39%
Cocoa	187	123	58	58	-70%	0%
Coffee	244	175	89	142	-42%	59%
Beef	199	117	115	76	-62%	-34%
Maize	322	162	120	124	-61%	4%
Soya	468	267	247	222	-52%	-10%

Source: ECLAC. Prices in US$ cents per pound, except for maize and soy beans which are shown as US$ per metric ton.

These price fluctuations have meant that in Latin America, although the volume of exports in the 1979-1992 period grew by 35%, the value of these exports only increased by 2.2%, reflecting a sharp fall in unit values.

Because of the instability of international prices for the most important products, it is necessary to create agricultural options that ensure greater economic stability of the production systems. During this same time period, purchasing capacity declined. A comparison of prices for these agricultural exports and prices of total imports in the region showed nearly a 10% decrease.

Given the possibilities of a greater market for tropical agricultural products, CATIE can contribute to developing sustainable production systems for coffee, cocoa, Musaceae and Sapotaceae, among others, by means of correctly characterized genetic material, integrated pest management, and the management of soils and water with cover crops and agroforestry systems. Genetic resources are not only important because of their contribution to boosting output or increasing resistance to pests, but because of their potential in adapting crops to naturally extreme conditions, such as acid soils and heat and water stress.

Environmental protection

A great threat to sustainability continues to exist throughout the region due to the accelerating and continuing degradation of natural resources, principally soils. Aside from acidity and low fertility levels, many soils suffer from exposure to erosion, nutrient loss, deterioration of physical structure and microbiotic composition, salinization and waterlogging. Deforestation, as much as poor agricultural practices (inadequate use of farm machinery, excessive irrigation, excessive weed control, incorrect orientation of rows, inadequate use of organic material and chemical amendments), are causes of this situation.

An analysis worldwide shows that water availability per inhabitant in the American hemisphere (Table 3) is, by comparison, the highest; however, it has fallen by 75% in fifty years.

The level of soil degradation by different causes in the American hemisphere (Table 4) is estimated to be about 25% of that in Africa and Asia. The principal cause of water erosion is deforestation and overgrazing; in the case of wind erosion, it is also overgrazing; and for physical and chemical soil degradation, it is poor soil management.

Soil and water contamination in agricultural areas is principally caused by fertilizers and pesticides. Of the fertilizers, those which are nitrogenated are the most critical. In the case of pesticides, herbicides are most used, followed by insecticides and fungicides. In the CATIE mandated countries, the annual expenditure for pesticides exceeds US$300 million for the six main crops.

Three things can be done in the agricultural and agroindustrial sectors to respond to these threats to the environment. The first has to do with the use of biodiversity. If, in fact, biodiversity is one of the comparative advantages of the countries of the region, the best way to conserve it and prevent it from being destroyed is to confer upon it an economic value through rational exploitation. The second is to provide producers with technological proposals that are environmentally compatible, including integrated pest management, organic agriculture and agricultural soil and water conservation practices. The third concerns techniques for re-utilizing raw materials and managing agricultural and agroindustrial residues and waste products, since many of these can be incorporated into the production system as bio-fertilizers.

Table 3. Water availability per inhabitant for distinct regions of the world, 1950-2000 period (in thousands of m^3)

Region	1950	1960	1970	1960	2000
Africa	20.6	16.5	12.7	9.4	5.1
Asia	9.6	7.9	6.1	5.1	3.3
Latin America	105.0	80.2	61.7	48.8	28.3
Europe	5.9	5.4	4.9	4.4	4.1
North America	37.2	30.2	25.2	21.3	17.5

Source: Ayibotele, N.B. "The World's Water: Assessing the resources" (1992)

Table 4. Soil degradation by region, type of erosion (in millions of has), and principal cause (percentages)

Region	Water erosion	Wind erosion	Chemical degradation	Physical degradation	Total
Africa	170	98	36	17	321
Asia	315	90	41	6	452
South America	77	16	44	1	138
North and Central America	90	37	7	5	139
Europe	93	39	18	8	158
Australia	3		1	2	6
Total	**748**	**280**	**147**	**39**	**1214**
Principa Causes (in percentages)					
Deforestation	43	8	26	2	384
Overgrazing	29	60	6	16	398
Poor soil management	24	16	58	80	339
Others	4	16	12	2	93
Total	**100**	**100**	**100**	**100**	**1214**

Source: ISRIC/UNEP

Table 5. Use of fertilizers, in kilograms per hectare.

Region	1988/90	2010	% annual growth
Latin America & Caribbean	71	117	2.4
Near East & North Africa	89	175	3.3
Southern Asia	67	133	3.3
Eastern Asia without China	86	141	2.4
Developing countries	62	110	2.8
Developed countries	120		
EEC countries	250		

Source: FAO

Food security

Food security has long been associated with staple grains which, together with roots and tubers, form the basis of human sustenance. Institutions such as CIAT, CIP, CIMMYT and IRRI conduct substantial research in these areas. CATIE research conducted in the past on roots and tubers showed good results and an important contribution could still be made there. In addition, the Musaceae, cucurbitaceae, pepper and tomato germplasm are invaluable assets.

Nevertheless, the Center's greatest contribution would be its research and transfer activities directed toward the development of basic systems for sustainable production combined with soil and water conservation practices. The "healthiness" of soil through improved physical structure and biology would provide the foundation for food security. Water, for its part, is a resource of multiple functions and uses in the rural sector.

Rural poverty

Rural poverty is an ever-present element of the agricultural sector and is now the focus of considerable attention in national and worldwide economic studies. The problem of poverty in Latin America was underscored by IDB President Enrique Iglesias in the recent annual Assembly of Governors held in Cartagena de las Indias, Colombia. According to Iglesias, there are 150 million poor in the region, amounting to 33% of the population. He added that the problem is more acute now than in 1980 when the external debt crisis began to surface. Rural poverty is a complex problem influenced by factors of infrastructure and socioeconomic policies; moreover agriculture is a risky activity due to the costs of production, the unpredictable attack of pests and the cost of their control, and the fluctuating prices of products on national and international markets.

In view of this situation, CATIE research could contribute with the development of mixed and agroforestry systems that reduce dependency on single products and allow producers to diversify their incomes. In addition, food security, soil and water conservation, integrated pest management, and the potential of genetic resources because of their tolerance of marginal soils, are important supports to prevent rural impoverishment and the deterioration of key production processes.

BENEFICIARIES

Direct beneficiaries are national institutions in the public, private and NGO sectors involved in research, extension and implementation of IPM and/or agroforestry activities who will receive novel scientifically evaluated technology, materials and research planning, as well as experience in collaborative development of improved sustainable systems and methods of implementation. Indirect beneficiaries are the producers of crops and trees in target systems, consumers, and rural communities as a whole, through improved or more stable employment opportunities,

higher incomes, less pollution and better health conditions. The world's scientific community will benefit from scientific inputs and knowledge related to sustainable agriculture. Society as a whole will benefit from a reduction in the levels of rural migration to cities and less encroachment on natural forests for agricultural purposes and timber extraction.

STATUS OF RESEARCH IN CENTRAL AMERICA

Almost all countries have a public sector research center usually attached to the ministry of agriculture or natural resources, where some research activities are combined with extension or service duties. Although universities also play an important role in research and have a considerable number of professionals with different academic degrees, their performance is only fully effective when funding is available for projects, since the demands of educational activities limit their research efforts

The regional centers conduct a large part of the development of research and training and strengthen institutions by providing definite data. Through their work, the boundaries between countries are overcome in order to accomplish research objectives. These efforts, however, appear to be limited by a lack of economic resources.

It is important to underline the great interest in activities related to germplasm, agricultural management and control of diseases, especially for staple grain crops, without doubt a reflection of the importance of this sector in the economy of the region. Because many of these activities are carried out in isolation, regional programs and networks are being created for research and development on specific crops.

CURRENT STATUS OF RESEARCH AT CATIE

Objectives

The general objectives are: a) to reduce pesticide use through the substitution of ecologically compatible alternatives, b) to reduce losses caused by pests, and c) to increase the research capacity for and rational use of biodiversity and natural resources. The main specific objectives of the proposed program are:

- To integrate, with other contributors and using a multidisciplinary collaborative approach, biointensive IPM and biotechnology practices into target production systems.
- To generate, develop and test technology inputs for use in target production systems based on current research strengths and demands identified in integrated systems.
- To generate knowledge on how to effectively mass implement IPM in target agroforestry systems and how to enhance producers' pest management decision-making capabilities.
- To respond to immediate plant protection demands of other groups working in target systems, through short-term, problem-solving research.
- To provide pest-related research support services to internal and external users in the fields

of agroforestry, plantation forestry and natural forestry management, including pest identification, phytosanitary characterization, assessment of the biodiversity of plants and other organisms, methods development and network coordination.

Goals for 1998-2002

- To protect biodiversity, especially of useful plants present in CATIE member countries, not only to conserve as a resource but also to characterize and utilize. This is one of the foremost activities according to institutional surveys in Latin America.
- To contribute methods and technologies that contribute to increases in production levels and resistance to pests for CATIE's priority crops. In cocoa, coffee and Musaceae, it has comparative advantages. In the development of tissue culture techniques, the Center is a pioneer and a leader in the region, as it is also for biological pest control and molecular characterization of cocoa and coffee. Genetic transformation is one of the important goals for the next century.
- To develop procedures and techniques for integrated crop management or agroecological management that reduce or eliminate the inappropriate use of natural resources. Plant protection activities in the last decade enabled CATIE to introduce the principles and practices of integrated pest management (IPM) in Central America.
- To undertake activities to promote the use of cover crops or green manures, alley cropping, crop rotation, the application of traditional organic material such as "bocashi" and compost, the improvement of substrates with beneficial microorganisms. All these basic elements improve the microbiota and structure of the soil and will enhance the rhizosphere of plants, improve the retention of humidity and prevent soil erosion.
- To promote definitive strategies to save fragile production systems and soils, including degraded tropical soils.
- To contribute to the adoption of sustainable tropical agriculture systems through participatory research. The experience of IPM activities in Nicaragua provides the region with a model of participatory research and implementation.
- To join efforts with other national and international bodies in order to prevent a duplication of research and teaching efforts.
- To develop specialized information systems on research in the priority areas of sustainable agricultural development.
- To participate in creating networks among national and international institutions dedicated to agricultural research.

Organization of research in lines and sub-lines

In 1997, the Board of Directors approved the areas and sub-areas of CATIE's Research Program. Present agricultural research is structured along the following lines and sub-lines:

Line 1: Improvement and conservation of germplasm of crops and forest species

Sub-lines

- Characterization
- Micropropagation
- Improvement
- Conservation

Line 2: Integrated pest management in agroforestry and forestry systems

Sub-lines

- Identification of pests and biological control agents in agroforestry and forestry systems
- Agricultural practices, biological control and decision criteria for the management of pests in agroforestry and forestry systems
- Development of methodologies for the implementation of integrated pest management (IPM) with producers

Line 3. Agroforestry systems

Sub-lines

- Agroforestry systems for the production of hillside annual crops
- Agroforestry systems for perennial crops
- Silvopastoral systems

Organization of research activities

The activities correspond to those suggested by the Board of Directors as being of priority in research: biotechnology, biological control, integrated pest management and organic agriculture.

The Areas of Tropical Crops and Agroforestry group present research activities in each sub-line. For each, a justification and detailed table of information is available.

In some cases, such as CATIE's IPM activities, in addition to addressing essential agricultural practices in sustainable production, the sub-lines of identification of pests, a basic component of management, and development of methodologies for implementation by farmers, are included.

Justifications emphasize the importance and necessity of research in the area of activity, including expected results. In the tables of inventories of activities, information is included on crops, duration of the research, partners, internal interactions, personnel and time allocated, and budget.

Line 1 (germplasm of crop and forest species) comprises 9 activities involving traditional and biotechnological studies to characterize, improve and conserve genetic resources.

Line 2 (integrated pest management) consists of 13 activities addressing IPM, with emphasis on identification, biological control, organic agriculture and methods of implementation.

Line 3 (agroforestry systems) is made up of 8 activities. Organic amendments and the use of growing supports for vegetable production are dealt with in connection with the production of hillside annual crops. A shaded coffee system and the organic production of coffee are emphasized in the case of perennial crops.

GUIDELINES FOR FUTURE RESEARCH AT CATIE

The areas of work most emphasized and their main activities are:

Assessment of the biodiversity of plants and other organisms

- Collection and introduction of germplasm
- Conservation techniques for genetic resources (seed viability, *in vitro* techniques, cryoconservation, core collections, etc.)
- Molecular and morphological characterization of genetic resources
- Multiplication of germplasm (vegetative propagation, tissue culture)
- Improvement of conventional and non-conventional phytogenetics (evaluation of genotypes, etc.)
- *In situ* assessment of genetic resources
- Characterization of phytosanitary problems and biological control agents in perennial crops and agroforestry systems

Development of agricultural and agroforestry systems with an emphasis on minimizing the use of agrochemicals

- Development of agricultural practices, biological control and genetic resistance, and decision criteria for pest management
- Management practices for the conservation and rehabilitation of soils and water
- Evaluation of the biophysical interactions in agricultural and agroforestry systems (competence, allelopathy, etc.)
- Study and naturalization of non-timber forest species

Development of methodologies for the implementation of sustainable agricultural technologies

- Methodology for participatory planning, surveying the public and measuring impact

- Methodology for joint implementation by rural families, technicians and specialists
- Methodologies of participatory research
- Development of expert systems

These areas are interrelated and have a rational and integral connection. In the first, the emphasis is on the need to recognize, value and make use of available genetic resources, not only of plants but also of other organisms with agricultural potential, for example, in the case of biological pest control. It includes promising innovative areas for CATIE to work, such as in the *in situ* assessment of genetic resources and the utilization of new biotechnology strategies for the conservation and/or utilization of germplasm. The potential of geographic information systems could also be tapped for *in situ* collection and characterization of germplasm and for agroecological records of pests and beneficial organisms.

The second area emphasizes the utilization and integration of natural resources, such as soil, water and plants, in efficient agricultural and agroforestry production systems. It also aims to answer the present need of generating resources for farmers and intangible environmental service products. Within this context, integrated pest management becomes one of the most important components of sustainability in the production system, especially through the use of novel techniques such as biological control, amendments and substrates, natural insecticides and traditional tactics with a broad environmental impact, such as the use of genetic resistance. All these elements support strategies to facilitate the development of organic production systems that counteract the adverse effects of high input-systems.

PURPOSE AND METHODOLOGY

The aim of the third area is to make the knowledge generated in the two previous areas efficiently available to interested parties. High levels of uptake are anticipated through the participatory research, as is consideration of the factors that affect the application of the technologies generated.

Some explicit components that may be implemented under each of these areas are defined below. This is not necessarily a comprehensive list and other components that are complementary or of immediate interest may be added.

The research activities will be carried out in all of CATIE's member countries, based on the needs, strengths and opportunities for collaboration with other CATIE technical areas and other partners. However, a major concentration of activities is expected in Costa Rica and Nicaragua over the next few years because collaboration opportunities have already been identified.

Although each individual situation will demand a specific methodological focus, the generalized scheme for IPM research activities (Figure 1) can be proposed for research in other technical areas. For problem identification and integration studies in the priority systems, it is imperative

that the IPM group and other technical areas work together. The priorities for the work to develop strategic technologies will depend on problems and demand identified in these stages.

The primary systems targeted for research collaboration and outputs will be shade-grown perennial crop systems (SGPCS), hillside mixed food crop / agroforestry systems (HAFS) and mahogany growing in plantations (PFS). The main agroecological zone for SGPCS and HAFS is expected to be the humid tropical environment (defined as areas receiving 1250mm or more of rainfall). The exact tree or crop/tree species focus in these systems will depend on detailed, often site-specific analyses of strengths and opportunities conducted by the entire target system team.

The case of HAFS merits special advance consideration. Because of the inherent variability of these systems and the lack of a single, unifying crop or tree species component, the focus will be on widely applicable practices and principles for the overall system. In the case of IPM, this will likely mean a dominant research focus on topics such as microbial control and management principles for generalist pests, organic and plant nutrition approaches to pest management, cover crops for weed suppression and fertility improvement, and pest interactions between tree and crop system components. Rather than be uniquely crop-based, it is considered that the target of this line of research should be the entire system. The characteristics of the system, rather than predefined crop priority criteria, will determine what research is required because crops and agroforestry species form part of an integrated system and management practices need to be compatible across the full range of crops and rotations the farmer wishes to practice. Nonetheless, the most common vegetable crops in these types of systems are beans, tomatoes, crucifers, green maize/sweetcorn and sweet peppers and will thus almost certainly self-select in many cases.

Overall, the IPM research line will combine original disciplinary and multi-disciplinary IPM research and multidisciplinary implementation-oriented research (MIOR) developed with other actors in the target systems. A balance will be struck between the competing demands of new research activities (major thrusts, readily identifiable in advance as keys to success in the system-focused approach), responsive research (demand-lead or problem solving) designed to address problems or opportunities that arise during MIOR activities, and research in areas of historic strength reoriented to produce outputs applicable to the new targeted systems.

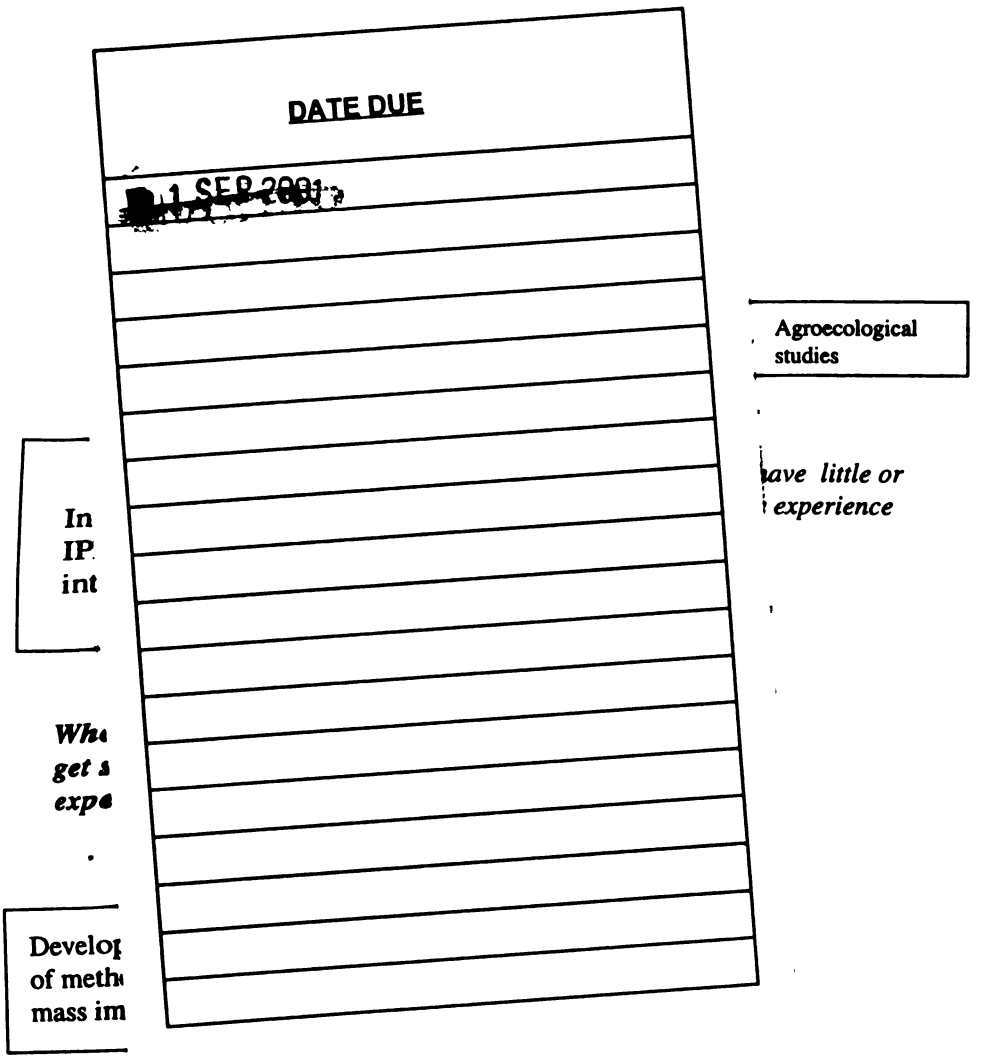


Figure 1. Representation of key phases in the IPM research cycles where prior experience and new areas exist.

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