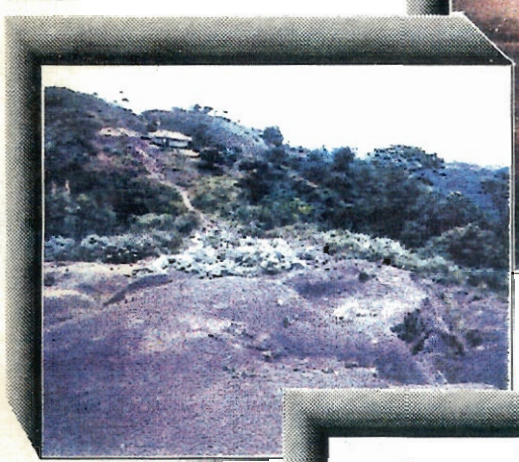
MAS—Managing Acid Soils*

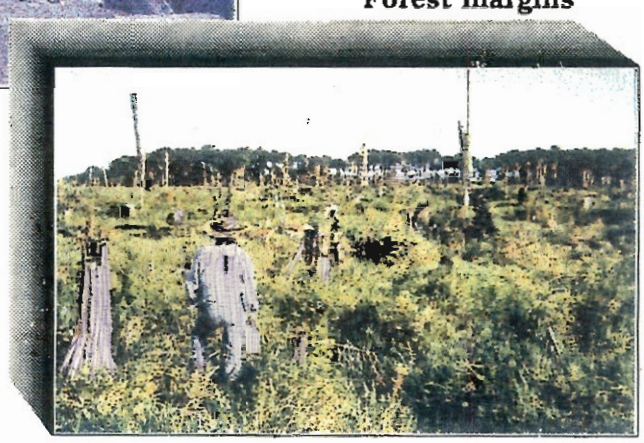
A research consortium that will strengthen agriculture's contribution to sustainable development in Latin America by focusing on integrated management of acid soils

Savannas

Hillsides



Forest margins



* The consortium's acronym—MAS—means "more" in Spanish. It underscores our conviction that a concerted effort to tackle the problems of acid soils in tropical America will have more impact (both in terms of agricultural production and conservation of natural resources) than previous efforts.

Summary

MAS is an interdisciplinary, multi-institutional consortium whose aim is to provide options for integrated management of acid soils—the infertile common ground of three major agroecosystems in tropical America: savannas, hillsides, and forest margins. Overcoming the biophysical limitations of acid soils is a fundamental requirement for strengthening the contribution of agriculture to sustainable development in this region.

National research systems; Latin American, North American, and European universities; and international research institutions will work in a complementary fashion in three study areas (each representing a different agroecosystem), following similar methods to address a common research agenda. The consortium will operate in the context of a broader program of research on sustainable land management, which various organizations are carrying out in the same study areas where MAS intends to work.

The consortium will draw heavily on past research and on farmers' experience to develop prototype production systems. To facilitate the application of these across agroecosystems, MAS will elucidate the underlying principles of integrated management of acid soils. It will also invest heavily in human resource development for national partners in this venture.

The Vicious Cycle

After a "lost decade" of deep recession, Latin America seems to be entering a period of modest economic growth. As farmers try to intensify production in response to new opportunities, agriculture will contribute importantly to this growth. But unless major changes take place in current patterns of land use, agriculture will also be partly responsible for extensive damage to soil and water, widespread pollution, and irreversible loss of biodiversity.

The region's forests are particularly vulnerable, both to uncontrolled commercial exploitation and to growing pressure from land-hungry immigrants. Any serious effort to alleviate the poverty that causes much of the deforestation and other environmental damage must deal with problems of land already under agricultural production in three major environments of tropical America: (1) savannas, (2) hillsides, and (3) forest margins (Figure 1).

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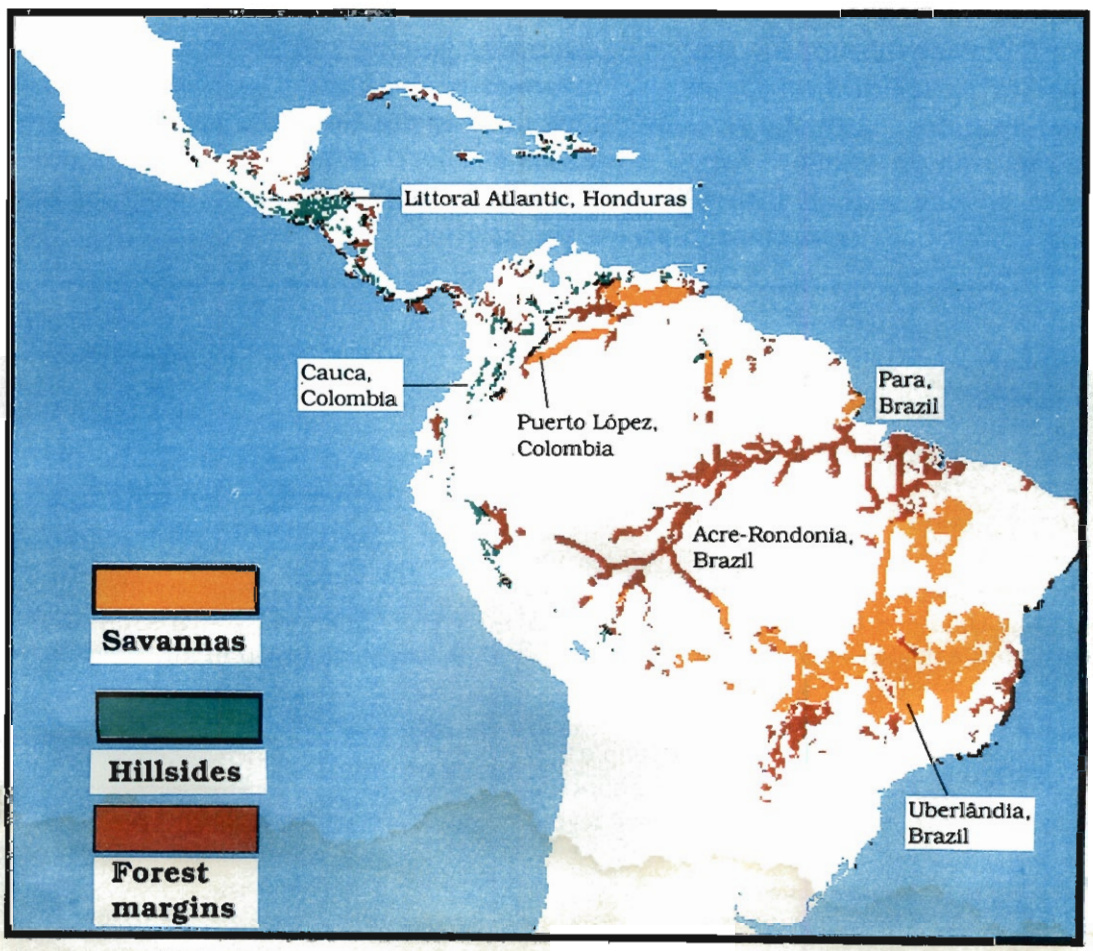

Figure 1. Candidate study areas in the tropical American agroecosystems on which MAS will concentrate. The estimated total extent of these environments is: savannas, 218 million hectares; hillsides, 97 million; and forest margins, 44 million (the total area of tropical forests in the region is between 500 and 600 million hectares). This map shows only those parts of the savannas (67 million hectares) and hillsides (10 million) that are legally accessible and satisfy other conditions (such as adequate rainfall) that give agricultural research a reasonable chance of having impact.

Savannas

The old status quo of extensive ranching is giving way to new systems of unsustainable monocropping and equally vulnerable grass pastures. Agropastoral systems that integrate crop and livestock production are more efficient than either of those options and permit more prudent management of savanna soils. If widely adopted on land already under cultivation or in pastures, these systems will convert the savannas into a regional bread basket—and without disturbing much of the land under native vegetation. The savannas will thus help satisfy the food needs of rural and urban consumers at reduced cost, contribute significantly to economic growth, and provide an alternative destination for some immigrants and much of the capital currently flowing into commercial exploitation of the forests.

Hillsides

Many small-scale farmers have turned to crop production in this environment because they lack opportunities in the fertile river valleys below. Using erosive farming practices and often felling trees to expand production, they are rapidly damaging both soil and water. These farmers desperately need a diverse array of new options that are economically attractive, environmentally sound, and socially acceptable.

Forest margins

Like their counterparts in the hillsides, farmers here fall into a vicious cycle of poverty reinforcing environmental degradation. Unable to obtain or afford production inputs, they invest their labor in clearing and burning forest vegetation, which releases only enough nutrients to maintain reasonable levels of crop production for a few years. As soon as yields taper off, farmers are compelled to clear more land. The challenge is to provide them with the means of producing sufficient food from the same land and thus to help stabilize this battle line in the struggle to preserve what remains of tropical America's forests.

Acid Soils: The Common Ground

Farmers in these diverse agroecosystems have a common problem. They lack the technology options and fair institutional and policy arrangements that would enable them to satisfy the need for increased agricultural production without exacting socially unacceptable environmental costs.

The environments in which these people labor also have something in common: acid soils, which are characterized by toxic levels of aluminum and manganese, limited availability of nutrients essential for vigorous plant growth, and high susceptibility to wind and water erosion as well as compaction, especially where farming is mechanized. One could recite a long litany of problems in the savannas, hillsides, and forest margins. But arguably none is more fundamental than the biophysical limitations imposed on these environments by acid soils—the infertile common ground of all three agroecosystems (Figure 2).

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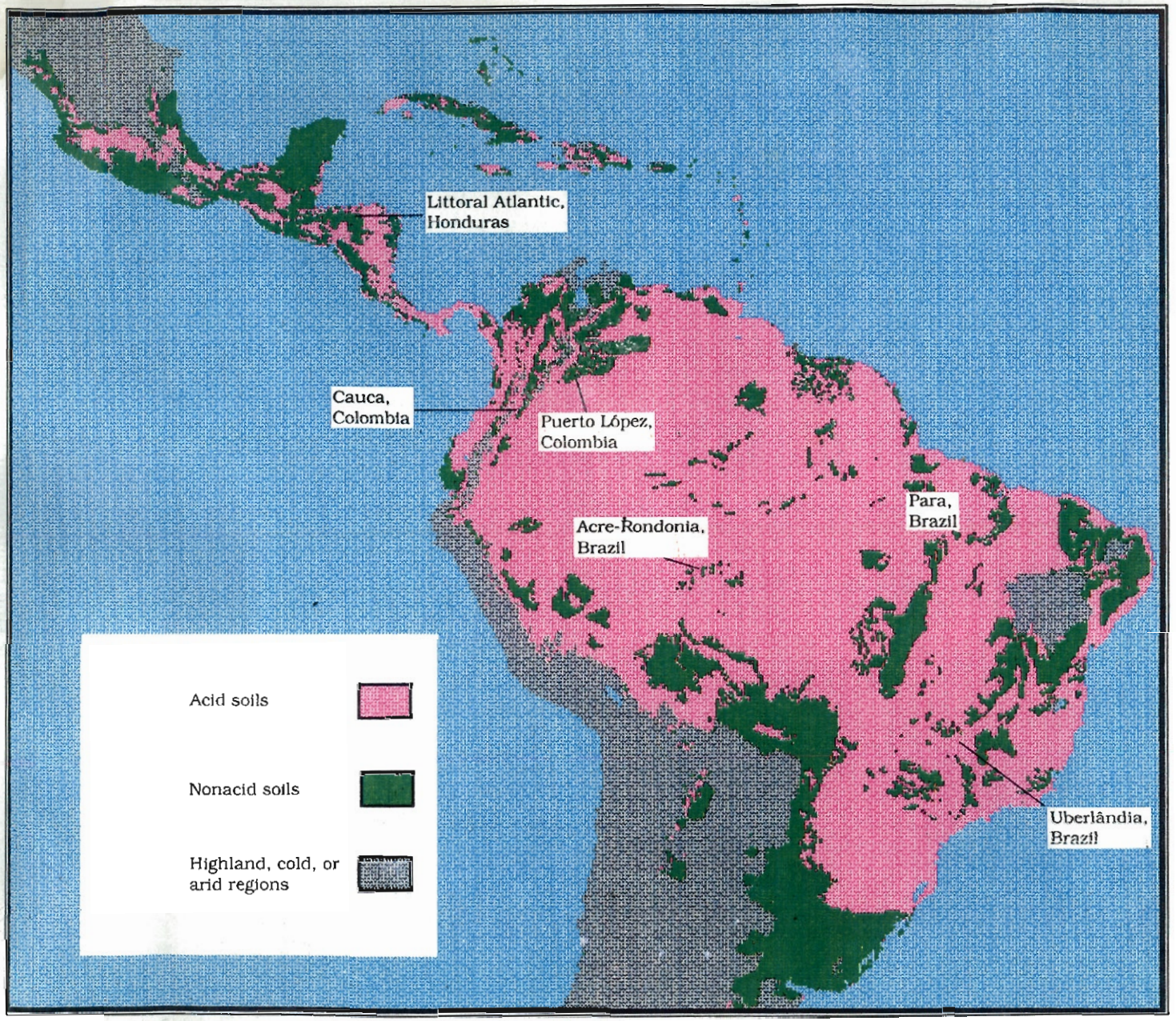

Figure 2. Extent of acid soils in Latin America. All of the savannas and forest margins, and about 10 percent of the hillsides, have acid soils.

Exceeding the Traditional Limits of Cooperation

Scientists and a very few farmers have demonstrated that some acid soils can be managed in an economically and environmentally sound manner. What will it take to turn their experience into a reality of land management in tropical America? Participants in a workshop on acid soils, held at CIAT in August 1993, agreed unanimously that the answer is an interdisciplinary, multi-institutional research consortium—unique in its organization and in its sharp focus on a common research agenda.

The institutions involved in MAS fall into three main groups, as indicated in Figure 3: (1) national research systems in developing countries, (2) universities in developed countries, and (3) international research institutions. Each brings a unique combination of skills and experience to the problem of managing acid soils.

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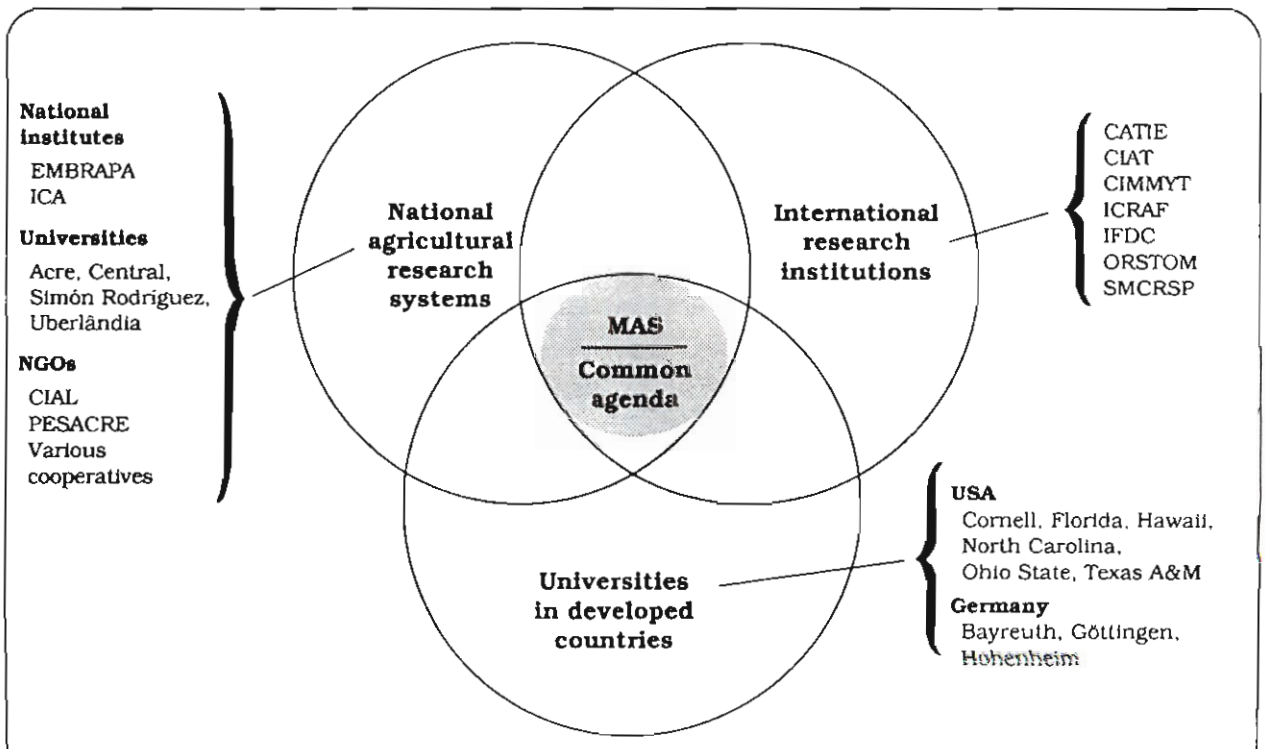

Organizations other than MAS participants that are conducting research on sustainable land management in tropical America

Agroecosystem	Organizations
Savannas	FONAIAP, ISPN, PROCITROPICOS, Various cooperatives
Hillsides	CETEC, CVC, IFPRI, IICA, SRN
Forest margins	GBP, ISPN, PROCITROPICOS, TSBF

Figure 3. Institutions participating in MAS and those working on issues that constitute the broader agenda of research on sustainable land management.

National agricultural research systems

The activities of government and nongovernment organizations range from problem identification at the farm and community level to strategic research and development of technology components with farmer participation. In research and training, universities have a special grasp of local problems and much potential to link degree study with the search for local solutions.

Universities in developed countries

Various universities in the USA and Germany have a long and fruitful history of research on soils in the tropics. They have accumulated large amounts of information, developed promising technology, provided training, and formed close ties with scientists in many countries of the tropics.

International research institutions

These draw heavily on the basic research capacity and other services available at universities to develop a broad array of research products in the context of an extensive network of national research systems. International organizations are thus uniquely placed to conduct comparative studies across countries and agroecosystems. They also provide an institutional common ground where national programs can come together.

Participants in MAS have already made significant contributions to research on acid soils. But they all know the frustration of limits imposed by their institutional settings. Universities have generally worked within the confines of country-specific bilateral projects, national programs within political boundaries, and international institutions within commodity mandates.

MAS proposes that all of these groups can accomplish more by exceeding the traditional limits of cooperation. That means sharing resources, working in a complementary fashion in the same study areas, and employing similar methods to address a common research agenda.

A Focus on Integrated Management of Acid Soils

The central objectives of MAS are to develop a range of options for integrated management of acid soils and to gain a deeper understanding of the soil dynamics that account for the success of some options and for the failure of others. The consortium will also invest heavily in human resource development for national partners.

The consortium will form three working groups, each aiming to develop options for one agroecosystem. Each group will concentrate on a single study area initially—to be chosen from two candidates for each agroecosystem. The six study areas (see Figures 1 and 2) were identified prior to the August workshop through a rigorous analysis, employing extensive data on key geographical and socioeconomic factors, and accurately represent the prevailing conditions and problems in the target agroecosystems:

Savannas	Uberlândia, Brazil Puerto López, Colombia	Compaction, erosion
Hillsides	Littoral Atlantic, Honduras Northern Cauca, Colombia	Extensive erosion, deforestation
Forest margins	Acre-Rondonia, Brazil Para, Brazil	Slash and burn cultivation at expanding agricultural frontiers

In these study areas, various national and international agencies (see Figure 3) are already developing a broad agenda of research on sustainable land management, encompassing topics such as agroecosystem characterization, analysis of policy options, development of innovative institutional mechanisms, and integrated management of pests and diseases. MAS will have ample opportunities to contribute to those activities, and its work will benefit from research done by others on a wide range of technological and socioeconomic issues.

In its own research, the consortium will concentrate on the three activities described below.

Development of prototype production systems

The participants in MAS have a sufficient grasp of the principal constraints in each agroecosystem to guide project planning. Even so, to gain a better understanding of predominant trends in resource management, and of the consequences, we need to conduct "cross-sectional" analyses in each study area. The idea is that, by sampling different patterns of land use over space, we can simulate what happens to land over time. The results will give us a baseline against which to measure the effects of alternative practices.

At an early stage in the research, each working group will put forward a set of prototype systems that show potential for reconciling more intensive production with preservation of the resource base. In the savannas, agropastoral systems seem to be the best bet; in the forest margins, agroforestry systems and more productive fallows will figure importantly; while the hillsides require combinations of these and other options. The exact form these options take will depend both on previous research and intense interaction with farmers in the study areas. We intend to make the most of existing knowledge and to closely involve beneficiaries in technology design.

The success of new options will depend, not just on proper soil management, but on adapted germplasm and appropriate combinations of species. For that reason MAS will evaluate on-farm a range of commodities for their suitability in the prototype production systems. In doing so, we will work closely with national and international institutions that have experience in identifying and developing germplasm with tolerance to acid soil conditions.

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Soil dynamics

As farmers evaluate prototype systems, interdisciplinary teams of scientists will study the soil dynamics of these options, elucidating the principles of sound management of acid soils and developing quantifiable indicators of sustainable resource use. To facilitate this strategic research, they will employ ecosystem models (CENTURY, for example) and other computer tools, such as the Acidity Decision Support System or ADSS (developed by TropSoils, the Soil Management Collaborative Research Support Program). The outcomes will provide a sound basis for extrapolating results from each study area to other locations in the agroecosystem.

Though it is hard to imagine how farmers can improve their management of acid soils with no external inputs at all, we have to assume that in many cases their access to these will be limited. Therefore, one of our principal tasks is to develop systems that derive maximum benefit from nutrients available within the farming system. To understand how particular systems use nutrients and other resources efficiently, we need more detailed knowledge about the processes affecting soil organic matter, nutrient cycling, and moisture both under fallow and in cropping systems.

Research on maintenance of fertility in acid soils must go hand in hand with a search for better ways to preserve their biophysical stability. Thorough analysis of the processes underlying soil compaction and erosion will give us a better basis for evaluating improved practices that aim to reduce these problems.

Soil bacteria and other microorganisms, insects, and earthworms play a key role in nutrient cycling, restoration of soil fertility, and detoxification of pesticides. Some cropping systems reduce both the numbers and biodiversity of soil microorganisms in the tropics, while others enhance them, though it is not clear exactly how or why. We need answers to these questions, so that we can find ways to maintain or even improve the soil's health and productivity through proper management of soil fauna and flora.

Much of the training will be decentralized, focusing on work in the consortium's study areas.

Human resource development

Ultimate responsibility for adapting prototype production systems to local circumstances and promoting them among farmers lies in the hands of national research systems. Every working group will emphasize training for colleagues in these institutions, covering each area of research in which MAS is engaged. Much of the training will be decentralized, focusing on work in the consortium's study areas. Degree training will probably involve tripartite arrangements between international agricultural research centers, universities in Latin America and universities in developed countries.

Skillful Orchestration

The success of MAS will depend both on the excellence of the research done by participating institutions and on skillful orchestration of their contributions. The consortium will satisfy both requirements by several means.

One is the working groups. Their immediate tasks will be to: (1) further develop the research agenda for each study area and agroecosystem, (2) determine the intention and ability of each participating institution to address specific items on the research agenda, and (3) prepare profiles of projects that will bring participants' expertise to bear on the agenda in a complementary fashion.

A steering committee, with rotating memberships that represent the main groups of participating institutions, will coordinate project activities and help donors target their contributions to the agenda items that interest them. Initially, CIAT will provide a chairperson for the steering committee and a provisional secretariat to facilitate the activities of the working groups.

The Time Has Come

In a time of shrinking research budgets, agricultural scientists in many institutions are trying to adapt their contributions to the requirements of new models for research on sustainable land management. To make meaningful contributions, we must change the way we work to get higher returns from the money available. This is precisely what MAS intends to do. Focusing on a well-defined common agenda, institutions in North America, Europe, and Latin America will work together to alter the perilous course of events in Latin America's savannas, hillsides, and forest margins. As CIMMYT economist Larry Harrington has put it, "The time for coordinated action guided by a common vision has come."

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Acronyms used in this document:

CATIE, Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica

CETEC, Corporación para Estudios Interdisciplinarios y Asesoría Técnica, Colombia

CIAL, Centro de Investigación Agrícola Local, Colombia

CIAT, Centro Internacional de Agricultura Tropical, Colombia

CIMMYT, Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico

CVC, Corporación Autónoma Regional del Valle del Cauca, Colombia

EMBRAPA, Empresa Brasileira de Pesquisa Agropecuária, Brazil

FONAIAP, Fondo Nacional de Investigaciones Agropecuarias, Venezuela

ICA, Instituto Colombiano Agropecuario, Colombia

ICRAF, International Centre for Research in Agroforestry, Kenya

IFDC, International Fertilizer Development Center, USA

IFPRI, International Food Policy Research Institute, USA

IGBP, International Geosphere-Biosphere Programme, Australia

IICA, Instituto Interamericano de Cooperación para la Agricultura, Costa Rica

ISPN, Instituto Sociedade, População e Natureza, Brazil

ORSTOM, Office de la Recherche Scientifique et Technique d'Outre-Mer, France

PESACRE, Pesquisa e Extensão en Sistemas Agroflorestais, Brazil

PROCITROPICOS, Programa Cooperativo de Investigación en los Trópicos (IICA)

SMCRSP, Soil Management Collaborative Research Support Program, USA

SRN, Secretaría de Recursos Naturales, Honduras

TSBF, Tropical Soils Biology and Fertility Programme, Kenya