

Report on a Workshop on
**Sustainable Agriculture on the Hillsides
of Central America**
Opportunities for Interinstitutional Collaboration



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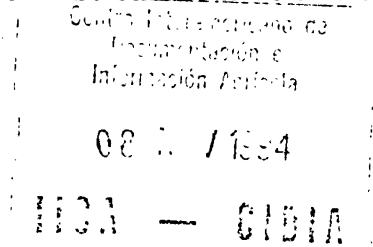


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Report on a Workshop* on Sustainable Agriculture on the Hillsides of Central America Opportunities for Interinstitutional Collaboration



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CATIE, Centro Agronómico Tropical de Investigación y Enseñanza
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* Simultaneously with the present abridged version of the Workshop, IICA is publishing the full proceedings in Spanish.

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Background

In late 1989, CIAT, following an initiative of the CGIAR-Sustainability Committee, began exploring the possibility of holding a workshop for Latin America and the Caribbean, to take stock of institutions and organizations working on sustainable agriculture in the region. CATIE, CIMMYT and IICA soon joined the endeavor, and intellectual input from several donor agencies and from local institutions was received in four planning meetings (between June 1990 and January 1991). Following their advice, the meeting's scope was narrowed down from Latin America and the Caribbean to the hillsides of Central America; and the focus was concentrated on opportunities for interinstitutional collaboration for sustainable agriculture. The *modus operandi* was to present a small number of conceptual papers, analyze a series of case studies, and discuss sustainability issues in working groups integrated with participants from the whole spectrum of relevant institutions.

Venue and Dates

The workshop was held at IICA's headquarters in Coronado, San José, Costa Rica, 13-16 August 1991.

Objectives

- * To take stock of institutions and organizations working on sustainable agriculture on the hillsides of Central America, and to characterize their systemic level(s) of intervention.
- * To identify constraints and opportunities for interinstitutional collaboration in research and technology transfer on sustainable agriculture.
- * To propose follow-up actions for devising and establishing interinstitutional collaborative mechanisms in sustainable agriculture.

Participants

The workshop brought together nongovernmental organizations (NGOs), national public sectors, and regional and international institutions and organizations; and the representation of the three groups was evenly balanced (closely to a third of the participating institutions corresponded to each of the groups). The list of participants is presented in Annex II.

Conceptual Framework, Case Studies and Special Cases

Three conceptual papers, seven case studies, and three special cases were presented and discussed. Their summaries follow. Institutional allegiances of senior authors can be identified in the list of participants (Annex II).

Conceptual Papers

The Concept of Sustainability in Agricultural Development: Notes for Discussion

by F. Torres

As a result of noxious effects on the environment caused by economic growth in some production systems, the goal of sustainability in agricultural production has finally emerged. Sustainability, considered as an up-to-date version of the continuous relationship between man and nature, has become an obligatory subject on the political agendas of developing countries and generates high-level political meetings.

Although sustainability has multiple definitions and a broad spectrum of goals, the objectives of sustainable agriculture can be grouped as follows: (1) production—a sustained increase in availability of goods; (2) conservation—maintenance of both the quality of services provided by natural ecosystems and their biodiversity; (3) social—achievement of an equitable distribution of benefits, respecting at the same time cultural

traditions; and (4) institutional—decentralization of levels of decision making in the management of natural resources at the level of ecological region, watershed, and community. The challenge is to achieve these objectives together.

Conflicts inherent to the development of sustainable agriculture involve ecological and economic aspects at the production level as well as those resulting from the interaction among social systems. Sustainability problems arise when there are discrepancies between private and social economic efficiency. It is then necessary to generate the institutional, economic, and technological conditions that mediate among the forces in conflict; therefore, these conflicts should be identified and their limits of influence marked.

Agricultural systems, which have an agroecological nature with socioeconomic functions, can be organized hierarchically, from a first level in plots where plants cohabit to regional or world economic communities. The more aggregate the hierarchical level, the greater the domination of economic aspects over sustainable development. The biophysical component, however, depends on resource management at the local level. The balance in sustainable agriculture therefore implies ecological, economic, and social factors that act within and among system levels.

Cases have shown that strategies applied globally affect national policies and producers' decisions. The system's performance at a hierarchical level is not derived exclusively from performance found at lower levels, and vice versa. From an operational point of view, each hierarchical level should be analyzed by itself and in relation to the other levels of aggregation (above and below).

Therefore, achieving sustainability at the operational level implies a balance between growth and conservation. The conflicts, and the balances that are established among them, are associated with specific levels of aggregation in the spectrum of farming systems. The design of sustainable alternatives should consider the balances that occur within and among the hierarchical levels.

There are five overlapping models to interpret sustainability and to approach the relationship between environmental management and sustained development: (1) growth; (2) environmental protection; (3) resource management; (4) eco-development; and (5) ecological.

The growth model aims at achieving greater economic efficiency through a market economy, using industrial agriculture as a means. The challenge is technological development that dissociates the economy from nature. Managed by producers.

The environmental protection model aims at maintaining the high production of industrial agriculture, but by controlling its noxious effects on the environment. Its strategy is based on regulation and control, and on natural parks (legislate the ecology). The challenge is to make short-term private returns compatible with long-term social returns. The model is controlled centrally and implemented in a decentralized way.

The resource management model aims at a long-lasting increase in the availability of goods and in the quality of ecological services, both based on the efficient use of natural resources. Its strategy is to promote institutional reforms and encourage technological changes optimizing the relationship between growth and preservation. The challenge is to integrate the market economy to nature's economy. Management is interdependent and among various governmental levels and producer organizations.

The eco-development model aims at integrated co-evolution between society and nature through reorganizing human activities so they operate synergistically with natural ecological processes. The challenge is to make demographic growth compatible with the natural carrying capacity of the ecosystems. Management is integrated within communities, among communities within ecoregions, and among ecoregions.

The ecological model aims at a harmonious relationship between man and nature (equality among biological species) by reestablishing the balance between man and nature around a zero-growth economy. Management of this model is decentralized. Cultural changes are required for it to be successful.

All these models indicate this topic's fluid state of development. A strategy should be developed without going to the extremes, combining the different models on an evolutionary path that depends on problems and opportunities that arise. The environmental model seems appropriate for maintaining high productivity of the industrial systems and integrated pest management points in this direction. Resource management would be the best strategy for degraded lands located in systems with limited resources or for fragile lands of the agricultural frontier (savannas and intervened forests).

The conceptual framework of the balances within and among systems and the diversity of approaches emphasize the need to formulate land use strategies that guide the design of policy incentives and appropriate technologies. The existing dependency among the hierarchical levels should be recognized as a fundamental concept of sustainable development.

A Geographical Analysis of Land Use in Central America

by S. E. Carter

This paper departs from the premise that land use is constantly changing as a result of the interaction of dynamic socio-economic and biophysical processes. Hence static pictures of land use are of limited utility if we wish to understand the origin and future of such patterns, or their possible sustainability. The objectives are twofold: to identify important processes which govern land use dynamics, and where they operate; and to suggest how inter-institutional collaboration can lead to a fuller understanding of how processes of change are manifest at different scales, as a basis for intervention to promote sustainable land use.

The paper presents an interim attempt to examine interaction between a range of spatial variables, derived from census information and from CIAT's environmental and geographic databases. A geographic information system was created for Central America, comprising environmental data (rainfall, dry season length, altitude and topography), land use data (area in annual and perennial crops, forest, pastures and miscellaneous uses, small farms and head of cattle) and socio-economic data (population data, literacy, water supply and road network). The data derived from censuses present a number of limitations for analysis, particularly the lack of a single base year between countries, and the lack of a time series to assess temporal change. However, the information included in the database was the most recent available for each country. Using the GIS, hillside areas could be rapidly characterized, and land use and socio-economic characteristics compared with those of the adjacent lowlands. In Central America, annual crops, pastures, forest, people, and small farms are concentrated on hillsides.

Techniques of simple correlation and factor analysis were used to identify important relationships between socio-economic, land use and environmental characteristics. These relationships were mapped and interpreted as the spatial manifestation of ongoing processes of change. Cluster analysis was

then employed to provide a regionalization of the Central American isthmus. This can be used to identify specific areas undergoing particular types of changes, an initial stage in the selection of sites for natural resource management projects.

The remainder of the paper emphasizes the limitations of data at a regional scale, and the need to repeat the geographical analysis at a more detailed level for particular areas of interest, to describe accurately the pattern and dynamics of land use within selected regions. Examples are drawn from El Salvador and Costa Rica. This process of continuously focussing in on areas and problems lends itself to participatory inter-institutional research and development projects. It presents the opportunity to draw on the experience and perspectives of institutions that work at different geographical scales in different fields. The study provides an analytical framework for implementing research on natural resource management in Central America, and a database which can be easily expanded and used to meet a range of different requirements.

Sustainable Hillside Agriculture in Central America: Institutions, Technology, Policy

by Eduardo Lindarte and Carlos Benito

Central America faces a growing crisis in its predominant hillside agriculture because of deforestation, loss of biological diversity, soil deterioration, and water contamination. Rapid population growth, an unsustainable development style, and unsuitable technology are also among the major causes of this crisis.

Technology can improve agricultural sustainability through environmentally compatible production techniques, remedial technology, and farming systems that combine trees, plants, and animals in beneficial ways. This adds to the complexity and magnitude of necessary research by increasing the components, interactions, and basic research involved. The growing complexity of knowledge application highlights the role of farm management and demands comprehensive extension approaches that can help farmers deal with variable technologies, conditions, and problems.

Diverse organizations have generated and diffused technology for coffee, basic grains, cattle, and, to a lesser degree, for fruits, vegetables, and other

perennials and trees. Institutional organization has been structured primarily around technology production, with little or no attention to sustainability concerns. Few organizations have concentrated on broad production systems involving trees, animals, and crops. Despite this limitation, the region does have an initial available technology basis for sustainable agriculture on hillsides; however, this technology requires substantial validation and expansion.

Agricultural technology efforts have developed mainly in governmental organizations and under the assumption of individual country self-sufficiency, despite the growing role of international actors (centers, networks, and donors). Other gradually emerging actors include universities and NGOs. Public research and technology transfer organizations (R & TT) have an excessive spread of activities, lack suitable funding and operational flexibility, and are losing their more qualified personnel. Extension and technology transfer arrangements are even weaker than those for research. Dealing with sustainability will only intensify such problems.

With regard to incentive structures, insecure property rights discourage soil conservation and interest in sustainable practices. Overvalued international terms of trade and failure of markets to consider natural resource depletion costs cause the income that farmers perceive to be much higher than the true social benefits. Import substitution policies and their institutional arrangements discriminated against agriculture, especially against small and poor farmers. Neither political mandates nor institutional arrangements have emphasized generating and using sustainable technologies.

Major changes necessary include assigning agricultural land to legally secure private property, raising real exchange rates, setting aside reserves and park areas, creating taxes to fund compensatory reinvestment in non-renewable resources, establishing rural development programs to encourage conservation among poor peasants, and implementing alternative employment programs outside of agricultural production. Improving the production, diffusion, and use of suitable and sustainable agricultural technology will require a specific mandate, incentives, and more coordination and combined action among organizations. The national challenge lies in developing a regionally comprehensive joint division of responsibilities, encouraging greater participation from private actors, and strengthening and redefining the role of public institutions.

Finally, specific proposals include developing national interinstitutional R & TT programs and a regional coordinating mechanism, reviewing research and networking efforts, implementing specific interorganizational pilot projects, and taking an inventory of sustainable technologies in the region.

Case Studies

Adoption and Diffusion of Minimum Tillage for Soil Conservation in the Metalio-Guaymango Region of El Salvador: Institutional Aspects and Technical Reflections

by

Fausto Calderón, Heriberto Sosa, Victor Mendoza, Gustavo Sain and Héctor Barreto

A description is given of biophysical, socioeconomic, and institutional aspects of adopting and diffusing minimum tillage for soil conservation in the Metalio-Guaymango region of El Salvador.

In 1973, the Guaymango Agricultural Extension Agency diagnosed the agricultural and socioeconomic situation of farmers in the Guaymango area. Land was used as follows: 44% was farmed; 44% was under native pastures; and the remaining 12% was under planted pastures, forests, and other uses. On the farmed land, the following crops were grown: maizelsorghum (64%); coffee (17%); maize (8%); sorghum (5%); and rice, plantain (guineo), and beans (6%). There were 1740 farms, with an average size of 3.5 ha.

Two basic problems were identified: (1) high levels of poverty; and (2) nutritional deficiencies and health problems. The farming systems' low productivity was considered as a cause of the high levels of poverty. A most important factor in the low productivity was the degree of soil erosion, which was closely linked with the method of land preparation, the burning of stubble, farm size and land ownership, and illiteracy.

The Guaymango Agricultural Extension Agency implemented a Program for the Use of Technology in the Production of Basic Grains (PPTGB in Spanish) and a Program for the Rehabilitation and Development of the Basic Infrastructure and Diversification of Agricultural Production (PREDIBDPA in Spanish).

The PPTGB created and promoted Solidarity Groups to organize small farmers, to provide them with access to credit, and to foster solidarity among members through formal and legal commitments to provide goods and services. The PPTGB also established a system of incentives by which those small farmers who adopt soil conservation practices would receive credit. Awareness campaigns on the damage caused by erosion were also carried out. The PPTGB considerably modified institutional relationships to improve the level of exposure farmers have to technical assistance.

Proposed technological alternatives were not experimented with nor validated in the region, but were structured according to the personal experiences of participating technicians. The pattern of technological change in cultural practices for the maize/sorghum system was characterized by (1) not burning the stubble, (2) clearing plot edges and uniformly distributing mulch over the plot, (3) more herbicide and fertilizer application, and (4) diffusion of new maize varieties.

The PREDIBDPA acted autonomously, collaborating with institutions of the area. Basically, it provided nutritional assistance to the families of its beneficiaries. To be a beneficiary, a farmer had to be a smallholder (with 0.4-2.0 ha) and member of a Solidarity Group, and had to adopt soil conservation practices.

In 1980-81, the promulgation of the Agrarian Reform law entitled a significant number of small farmers to own land, resulting in a change of attitude that was positive toward the adoption of soil conservation practices.

The most important technological improvements were: not to burn stubble and to maintain soil cover by using mulch. These two factors, associated with the use of new varieties and modest levels of fertilization, probably created a long-term impact on agricultural productivity. The productivity of the maize/sorghum system gradually increased from 0.97 t/ha of maize in 1974 to 3.25 t/ha in 1989, and from 0.7 t/ha of sorghum in 1974 to 2.1 t/ha in 1989.

The impact on productivity is also reflected in the success of the PPTGB, which, in its two years of duration, constructed 230 units, benefiting 177 farmers.

The adoption of minimum tillage for soil conservation in the Metalio-Guaymango area was successful, thanks to the influence of institutional factors, to agronomic knowledge, and to the presence of an

integrated system of technological diffusion linked with credit. However, it must be admitted that the presence of cattle in the farming system is an important factor in conditioning the technology's success.

Integrated Validation of Technology in the Southeastern Region of Guatemala, a Systems Approach with Interinstitutional Participation

by Carlos Heer A. and J. Ernesto Celada R.

To strengthen the technical and operational capacity of Guatemalan institutions, a project for developing integrated production systems (crops, cattle, agroforestry, home economics) is proposed. The project is directed toward rural hillside zones in the dry tropics of Central America, with limited forest resources, and toward low-income producers who use their farms mainly for cattle raising.

The Jutiapa area was selected, where pastures have been degraded by overgrazing and forest fires, and where erosion has worsened because of reduced tree cover and limited precipitation. The soils are suitable for growing pastures and undifferentiated shrubs-crops. Twenty-three percent of the population is urban and 77% is rural. This area also has severe problems of infrastructure in health and educational services and, despite a regionalization effort by many institutions to form the Public, Agricultural, and Nutritional Sector (SPADA in Spanish), conditions of small and medium producers have not improved.

Difficult environmental conditions; accelerated population growth; imbalance in the amount, availability, and use of water; low technological levels; and weakening of the agricultural public sector all diminish resources, cause their deficient utilization, and increase rural poverty. Two prior experiences, the SPADA-ILCA project and the PROGETTAPS model, attempted to improve these conditions, but their programs did not have the expected outcome.

For these reasons and in order to achieve recovery and conservation of the environment, the CATIE/ACDI project was designed, whose methodology is participatory. The project (1) identifies problems in producers' farming systems through multidisciplinary and interinstitutional teams; (2) conducts an inventory of the available technology that is adaptable to conditions in the

region, and workshops to prioritize problems and technologies available for validation; and (3) designs operations through a matrix of problems and prioritized options, from which technologies are selected that will affect, in an integrated way, at least two or more subsystems. The technologies were discussed with farmers, sharing criteria on perceptions of the region's problems and the levels of productivity associated with the deterioration of natural resources.

The CATIE/ACDI project uses the production systems approach; operationalizes its actions in a single intervention unit; is structured within the institutions' sectorial and regional policies; enjoys total participation from families who are coexecutioners of the project; and integrates actions of more than one institution in order to solve a concrete problem.

Case Study of Sustainable Agricultural Development in the Hojancha Region, Guanacaste, Costa Rica

by Oscar Campos, Emel Rodriguez and Luis Ugalde A.

Some definitions of sustainable development are reviewed, emphasizing the importance of information on this type of experience for projects related to sustainability. The colonization process of Hojancha (Guanacaste, Costa Rica) produced important changes in the agrarian system, such as the transition from cropping to cattle raising, an activity that marked the beginning of its prosperity in the 1950s. The opening for beef exports to the United States and good cattle prices made this activity competitive. Soft credits from the national banking system, which considered beef exports as a development alternative, stimulated and accelerated the cutting of the few forest reserves on each farm in order to plant pastures. Between 1935 and 1963, the cattle population increased by 800% and the first emigrations of families from farms smaller than 10 ha began, due to lack of competitiveness. In the 1970s, this development model fell apart when beef prices dropped; as a result, the highest emigration (57%) recorded in the region occurred.

The failed model of extensive cattle raising for export left soil exhaustion, alterations in hydrological cycles, erosion, and high unemployment. At that point, those colonists who had not emigrated organized themselves and started, together with state organizations, a program for economic reactivation in the region.

With the organization of an integrated rural development program, the Centro Agrícola Cantonal de Hojanca (CACH) was formed in 1978, which joined both farmers and personnel from communal institutions in the agricultural sector. Projects for reforestation, coffee growing, apiculture, dual-purpose cattle raising, and basic grains were established. The organization's resources in the beginning came from donations from international organizations; nowadays it is self-sufficient (in operational costs) and receives soft credit from the IDB.

Extension and training activities include an on-farm demonstration plot, very active participation from farmers, and excellent institutional support and coordination, because each institution is given direct responsibility.

In the forestry project, an area of 1,224.4 ha was reforested between 1978 and 1991, with participation from 614 farmers. Agroforestry systems were introduced, especially trees associated with coffee, and the level of training on the use of soil was improved. The coffee growers' cooperative was reactivated, and a plan to promote coffee growing, financed by the national banking system, was restarted. Farmers adopted agroforestry techniques to reduce the amount of light in coffee fields or to incorporate organic matter with legumes. Impetus was also given to improve pastures and cattle: a forage conservation program was introduced (hay and silage), places for collectively cooling milk were constructed, and a plan for collecting the product was designed, with the establishment of a regional receiving point in 1983 under the National Milk Producers' Cooperative. Likewise, maize, bean, and rice production were reactivated, to the point of self-sufficiency. Farmers have accepted the agroforestry systems with associated crops (maize, beans, or rice), and the practice of beans under cover in the forest plot has become common. Local groups that were formed were the Asociación Guanasteca de Desarrollo Forestal (AGUADEFOR) and the Consorcio Cooperativo Cafetalero (COOCAFE).

Factors that contributed to the success of the development of sustainable forestry and agriculture at Hojanca include development of an organizational and operational structure; and institutional development with regard to credit, education, communal organizations, development associations, training, and agricultural extension. For sustainable development, there should be communication with bases, and periodical and systematic self-evaluations. Agricultural diversification was effective in

solving the problem of emigration at Hojancha, allowing the local economy to grow.

The success of integrated rural development programs depends on effective communication with farmer organizations and institutional coordination. The role of the farmer organizations (with timely training and resources) in the search for development opportunities is essential. Improved bases for providing education and planning that will make sustainable agriculture possible are sources of work that will allow the farmer to improve his standard of living. Forestry activity and the conservation of resources play an important role by developing programs of sustainable agriculture with farmers.

***The Chiriquí Viejo Case:
Agroecological Impact of Agricultural Production on the
Hillsides of the Upper Chiriquí Viejo River Basin***

by Amílcar Beitía

The upper Chiriquí Viejo river basin (Panama) is a mountainous area of 60,300 ha, with slopes of more than 45% over 61.5% of the surface. Although soils are deep and fertile, 56% of the total area is affected by erosion through runoff. Land is used for forests (natural, planted, gallery, with fallow, coffee, and vegetables), farming (vegetables, perennials, traditional cropping), cattle ranching (clean pastures and degraded natural pastures), infrastructure (towns), and national parks. The subcategory of forest with coffee is of primary economic importance (4572 ha, that is, 7.5% of the basin area), as it contains the country's main coffee-growing farms. Cattle ranching accounts for 46% of the land being used, and its development is exerting great pressure on the forests in the national parks, as it converts hillsides into pastures. Two thirds of the basin area are devoted to farming. Vegetable growing and cattle ranching on steep slopes have lead to erosion and landslips. Development strategies and policies regarding technology transfer, agricultural credit, and marketing are very poor.

More than half of the population is concentrated in the basin, thereby creating pressure on the forests to convert into farming land. Regarding land tenancy, most farms (65.4%) have no titles.

During 1966-1990, a total of 17,333 ha of forest in areas with high risk of soil depletion was cleared for farming and pastures. Because of the high risk of soil degradation, it is necessary to establish programs that ensure sustainability and also increase productivity to meet the rising food demand in the area. Population growth during 1980-1990 (48.9%) indicates a future need for land. The production technology used by farmers in the area does not preserve natural resources (soil and water), thus leading to their depletion, and so to deficiencies in crop and forest production systems, loss of genetic diversity, poor services and infrastructure, poor quality of life, and poor institutional development. Although the government, private conservation institutions, farmers, and institutions are aware of the consistent depletion of natural resources in the basin, the lack of political and economic resources is a major bottleneck to positive action.

It has not been possible to establish an agricultural development plan adjusted to the reality of the country, because planning has always been subject to fluctuations in national policy. Neither is there any institutional leadership regarding the conservation of natural resources. Even though this is nominally the responsibility of INRENARE (Instituto de Recursos Naturales Renovables), lack of financial resources prevent it from performing its duties.

The Soil Conservation Project, directed by the Ministry of Agricultural Development (MIDA), 1981-1987, and favored by farmers, established plots to demonstrate conservation practices. However, its effectiveness was lost as political conditions caused AID to withdraw before the end of the project and other institutions involved suffered financial difficulties. Confronted by institutional inconsistency and the oversight of their needs in the decision-making process, the community did not cooperate.

Major issues for discussion and analysis regarding the upper Chiriquí basin are land tenancy, ways of fostering conservation programs, developing functional strategies to protect national parks, activating marketing mechanisms to reduce farmers' uncertainty, developing mechanisms to foster environmental education, creating alternatives to conserve fertile hillsides susceptible to erosion, constructing mechanisms to facilitate institutional integration, and developing credit policies that favor environmental conservation.

The Case of Cabricán, Quetzaltenango, Guatemala

by Francisco Arriola and Rudy Herrera

The municipality of Cabricán, in the western highlands of Guatemala, is characterized by very rugged mountains and deep ravines. Agriculture is the most important activity of the region: more than 1700 metric tons of foodstuffs (maize, wheat, beans, and potatoes) are produced in an area of 1500 ha. However, the predominance of the small farm, the use of soil with potential for uses other than agriculture, low levels of technology and productivity, limited agricultural extension services, and insufficient technical credit assistance have hindered agricultural development in this region. Small farmers (those who have productive units under 3.5 ha) own 43.5% of the land (1200 ha, that is, 90.1% of the total number of farms). Small producers (productive units between 3.5 ha and 22.5 ha) own 34.5% of the surface area (9.6% of the total number of farms). Transitional producers (productive units between 22.5 ha and 45.0 ha) own 1.6% of the land (0.1% of the total number of farms), while 18.6% of the land (493 ha, that is, 0.2% of the total number of farms) is in the hands of commercial producers (productive units larger than 45 ha). These data reflect the predominance of the small farm.

The development strategy designed by the government is based on planning from the bottom to the top. The country is divided into regions by law: there are local development councils at the village level, and municipal, departmental, and regional development councils. In Cabricán, local and municipal councils operate jointly with committees on soil conservation, nursery formation, and agroforestry projects, and with committees on village development and introduction of drinking water.

In this region, soil resources with forestry agrological capacity have been typically used for clean crops; this, together with inadequate cultural practices, has contributed to soil deterioration. The new technology for using soil and forest resources has been a direct result of: pressure to use land for cropping activities; current small-farm operations; obtaining wood for domestic purposes; and subsistence conditions of most farmers.

In 1975, therefore, the Agroforestry Project DIGEBOS/CARE/Peace Corps was created to promote the rational and sustainable use of the region's soils and forests. Soil management and conservation practices

implemented included constructing filtration irrigation channels and terraces, planting pastures to protect slopes, incorporating compost, and establishing live barriers of stubble and rock. Trees have been incorporated into agroforestry production systems, forest and fruit plantations, and establishment of live fences. Village agroforestry committees have played a fundamental role in the introduction and adoption of these technological alternatives. Likewise, the government has been taking a growing interest on this front.

Technicians and institutions have perceived the importance of the local population's participation for the success and continuity of the projects. Institutional coordination itself is an equally important factor, having contributed satisfactorily toward this specific agroforestry project.

The project's success in solving the initial problem was based on having reached all the villages in the municipality. In addition, the quality of the work developed allowed the community to become aware of the importance of the sustainable use of natural resources. Activities were not imposed on the community, rather, the people themselves identified and proposed viable solutions to their needs and problems. The use of foodstuffs for work was a good incentive, improving the economic situation and, at the same time, permitting people to subsist. However, this system should be managed with caution because it is sometimes difficult to differentiate participation for mutual benefit from participation for personal interest. The promoter should be a native of the community and a natural leader; people will therefore have confidence in him/her, and will more readily accept the innovations that the project proposes to them.

The adoption of technological alternatives has had the following results: through the use of terraces and filtration irrigation channels, degraded land has been recovered, thus increasing harvests. This increase in productivity has reduced emigration to commercial producers' farms to seek temporary work. Incorporating trees into production systems on established plantations has increased the availability of wood and other products of rural use, thus reducing pressure on natural forests.

The sustainability of these activities is based on the project's capacity to continue with very limited external assistance, and its ability to begin programs built on the conviction of participants regarding the potential benefits. To perceive these benefits, information should be obtained on: the benefit:cost flow for an activity; the distribution of benefits and costs per

activity; the degree of the participants' understanding of the existence and distribution of the flow of benefits and costs; and the participants' ability to incur the cost of activities before beginning to see any benefit from them.

***The Human Farm:
Principles and Practices of Sustainable Agriculture on Hillsides***

by Elías Sánchez, Milton Flores and Ismael Vargas

One starts with a conceptual framework in which the farm is the reflection of knowledge, skills, and degrees of motivation of the individual, who, in turn, is defined as the human farm—an idea that forms the backbone of any agricultural improvement program for hillsides.

Human hillsides are defined as the impediment that should be eliminated in order to achieve an objective; they are of genetic or sociocultural origin. In the latter case, they arise as a result of underutilization of basic tools: the brain, hands, and conscience. Therefore, to cultivate the human farm is to facilitate conditions so that the individual can think.

*The practical implications of exchanging the technology transfer model for a model of living together and teaching the **What, Why, How, and What for** are discussed. The methods that generate, reinforce, and make learning permanent have been replaced by institutional strategies (subsidies, credits, objectives, and institutional goals). These strategies are temporary, that is, they last as long as the exterior source of motivation is present. Only changes that affect emotions, thought, and action generate permanent changes.*

Agricultural sustainability is based on changes in the thinking, awareness, and action of people, and on the understanding that productive processes are live processes. Transferring this knowledge is what makes it possible for people to see the need to protect and maintain conditions that will satisfy the basic needs of the soil. Institutional strategies should consider these factors to avoid the changes they initiate being only temporary.

Our teaching methodology should be based on simple principles (begin on a small scale, live with other people, respect culture, motivate, offer a multiplier effect, and satisfy). Institutions such as CATIE, CIMMYT, and CIAT are called upon to promote this approach among the programs and projects that they support.

It is necessary to seek didactical alternatives that will facilitate people's learning process. One should not concentrate so much on dissemination of techniques, but rather, consider them as didactical instruments.

Case Study of the Acosta-Puriscal Microregion, Costa Rica

by Ramiro Jiménez and Olman Quirós

An analysis is given of institutional response to problems in the Acosta-Puriscal region of Costa Rica, involving natural resources management and agricultural production.

Regional problems originated with the emigration of small farmers from the Central Valley as a result of development policies inappropriate to the biophysical conditions of the region and which, consequently, led to a progressive decrease in agricultural production and increase in deforestation. The technology used was an indiscriminate slash-and-burn of forests to establish annual crops in monoculture, thus initiating irreversible soil deterioration. Currently, problems can be considered to be institutional, technological, site-specific (biophysical and/or socioeconomic), or financial.

Institutional problems result from narrow institutional policies and programs, collateral projects with similar objectives and poor coordination, lack of medium- and long-term planning, lack of programs oriented toward creating public awareness of the need to conserve natural resources, lack of political support to execute laws and decrees on interinstitutional coordination, and vertical (up-down) planning of programs and projects.

Technological problems include application of technologies unsuitable for slopes; extensive cattle raising; low production; inappropriate use of soils, with resulting deterioration; high rate of deforestation; and lack of medium-term production alternatives.

Biophysical and socioeconomic factors that contribute to the complex of regional problems are low incomes from agricultural activities, emigration (especially of young people), steep slopes, and high rainfall. Financial aspects can be summarized as: poor existing markets, lack of integrated credit facilities, and high costs involved in recovering degraded natural resources.

Governmental and private institutions have become more aware of regional problems, and several projects have been created for soil conservation, reforestation with participation from small farmers, environmental education, promotion of agroforestry systems, and support for small farmers in the production of staples. Of these projects, the soil conservation project has had the greatest impact, particularly in the case of tobacco; likewise, coffee, cacao, citric, and leafy ornamental crops have been established. Through the soil conservation program, a total of 1082 ha has been planted in crops; the reforestation project has involved about 975 ha.

These achievements were supported by the opening of new lines of credit with low interest rates and by assistance in operative expenditures of quick transactions from the institutions involved. Although mechanisms of interinstitutional coordination do exist, informal mechanisms have proved to work better.

In conclusion, the region's biophysical and socioeconomic conditions make adequate soil management difficult where annual crops and extensive cattle raising are used. Likewise, medium- and long-term policies are needed to promote the recovery of degraded land, and projects should be planned horizontally, with the participation of both technicians and beneficiary farmers. A regional entity with financial resources to support agricultural and forestry institutions is also needed. Integrated lines of administrative credit should be opened, with respective training and assessment. Efforts should also be directed toward the generation and promotion of slope-oriented technology. Strategies should be identified that will allow the sustainability of technical and financial cooperation projects involving national and international entities. Farmers, once aware of these problems, should be stimulated to invest in improved soil management as the basis of the sustainability of their agricultural and forestry activities.

Special Cases

The Sierra Plan: an Attempt to Ecodevelop Tropical Hillside

by Inmaculada Adames and Blas Santos

In order to recover the forest cover of the principal hydrographic basin of the Dominican Republic, the government proposed the Sierra Development Plan, whose objectives were: to reestablish the vegetative cover; reduce erosion; and provide health services, education, and road infrastructure. Implementing this Plan will improve hydroelectric utilization and irrigation of the dry part of the Valle del Cibao, the region with the highest agricultural production, thus lowering the use of petroleum and imported foodstuffs.

The ecological restoration included planting forests for productive purposes (60% of the area), planting coffee under the shade of legumes (18%), reducing food production area (4%), and planting improved pastures (18%).

The social and technological component of the project involves land partition within an agrosilvipastoral system that provides food, income, and occupation and development of (1) physical works for soil conservation; (2) production and use of organic fertilizer; (3) growing green-manure crops, using fast-growing species; and (4) modification of traditional planting systems to increase protection and use of terrain. Forests can be privately owned (associations of forest owners or small farmers living within the forests), collectively owned (communities), or state-owned. There is also an intention to intensify coffee growing, starting with pastures and continuous cropping areas. Using improved pasture varieties is foreseen, along with rotating pastures and planting legumes.

An evaluation in 1985 showed that, in spite of the economic crisis, the Plan had advanced (1) in the area of services and infrastructure; (2) in the organization of the Celestina community forest and the elaboration of forest inventories; (3) in reforestation; and (4) in the successful promotion of coffee, with good acceptance among medium landowners. The pastures program could not be developed because of technological difficulties, and these systems continued to contribute large amounts of sediment to reservoirs, thus losing the support of inhabitants of river bottoms.

In the second part of the program, a technological package of small-farm production was developed to solve the problem of continuous cropping and to expand the space gained in the forest area and in coffee. The forest project is now self-sufficient. The cost-benefit analysis of the different transformations proposed, natural forests to managed forests, extensive pastures to coffee, and traditional continuous cropping to stable continuous cropping or coffee, indicates that productivity of land has increased with technology and alternative uses of soil. Although forest activity could cover its own costs, the transformation of pastures into forests required heavy subsidies.

The principal difficulties presented in the development of the plan were: (1) the limited institutional capacity for carrying out research on soil management on tropical hillsides; (2) the adoption of systems that degrade the environment by inhabitants of the Sierra, who, as immigrants from lowlands, do not have mountain culture; (3) the economic crisis of the country, which forced requests for international donations; (4) uneven land distribution, which made the overall application of the program difficult; (5) the lack of interinstitutional coordination; (6) confusing legislation on land use, whose application depends on political situations and those of officials; and (7) the limited political disposition that made both economic support and application of the legal base difficult. However, support obtained from Dominican society and from the international community cushioned this last factor. The country's economic difficulties and the distribution of funds according to electoral benefits do not favor this type of project over the long term.

Alternatives for Converting the Foreign Debt of Central American Countries

by

**Gamaliel Alvarado B., Roberto Avendaño Ch. and
Carlos Isaac Pérez M.**

A general overview is given of the practical applications of converting foreign debt, as based on the Costa Rican case, which has had broad experience. Attempts to reduce the debt give rise to different conversion mechanisms or programs as borrowers search for ways to reduce part of their debt by exchanging it for less than its nominal value while promoting

certain economic activities of special interest, such as the generation of foreign exchange, development of deteriorated areas, and even privatization of public entities.

The original, simplified, mechanism works as follows: the government or central bank of a given country establishes activities for either overall development or on an individual case basis, together with the corresponding regulations. Interested parties submit to governmental authorities the projects they want to develop, and the financial conditions under which they will exchange (the percentage of reduction acceptable to both parties). Once the transaction has been agreed upon, it is legalized and the foreign debt cancelled. The interested party receives cash, foreign debt bonds, or a combination of both. This procedure can be of two types: commercial or social. Variations of this mechanism can be developed: the debt can be exchanged for products, development, debt, education and development of small enterprises, and natural resources.

Over the last three decades, the foreign debt of Central American countries can be classified as commercial (with banks), multilateral (with international financial organizations), or bilateral (with foreign governments). The enormous foreign debt of these countries reaches US\$25,183 million, adversely affecting their economies and resulting in production stagnation, inflationary pressures, exchange instability, generation of social inequalities, and poverty.

Conversions carried out to date have been through the use of the commercial debt; these sums have been limited, and exchange constitutes just another alternative for the negotiation process. Countries, such as Mexico, Philippines, Costa Rica, and Uruguay, that have used the Brady initiative, have succeeded in including clauses in agreements with international commercial banks that establish conversion of debts to development projects. This initiative, directed only to credits with commercial banks, covers countries developing economic programs that attract foreign investment, strengthen internal savings, and promote repatriation of outgoing capital.

The International Monetary Fund and the World Bank provide financial support for the transactions that reduce the commercial debt. Debtor nations must maintain programs for converting the debt to capital or for development and, at the same time, allow local investors to participate in the transactions. Commercial banks should proportion debtor countries new

financial resources in the form of credits, project funding, and voluntary loans. Creditor countries should continue with their policy of restructuring the bilateral debt.

This bilateral debt, which accounts for 48% of the region's total debt, is considered eligible for conversion. In the Initiative of the Americas, there are several options for its use in conversion programs at both governmental and private sector levels. The Bush Plan provides the option that other creditor countries follow this example and, through the Paris Club, allows debtor nations to exchange the bilateral debt for projects of broad social, commercial, and environmental interest.

Activities eligible for financing include, among others, conservation and development of sustainable agriculture; territorial planning; development of solvent natural forest management systems; forestry-based industrial development; establishment, recovery, protection, and maintenance of wilderness; and research, education, and administration of sustainable development.

The experience of countries that have exchanged their debt for specific projects has been positive. Regional workshops should therefore be conducted so that other interested countries can tap information on existing mechanisms and possibilities. In Latin America, these workshops can be carried out for three areas: (1) countries of South America; (2) countries of Central America, including Mexico; and (3) countries of the Caribbean region.

Sustainable Agriculture on Central American Hillsides: Opportunities for Interinstitutional Collaboration

by Bernd Neugebauer and Roland Bunch

In 1983, experiments were begun in Yucatán, Mexico, with green-manure crops that require little investment and are capable of growing in marginal soils under minimum tillage. They were intercropped with maize, the region's traditional crop. After two years of experiments, small farmers in the Programa de Vecinos Mundiales in Honduras, whose principal objective is soil restoration, replicated this technology, proving the viability of intercrops with various green-manure crops. Since 1987, thousands of

*small-farm families in Honduras, Yucatán, and other countries adopted the system of intercroops, using *Canavalia ensiformis* and *Stizolobium* spp., and successfully introduced permanent crops in areas where slashing, clearing, and burning were practiced.*

The Program's proposed goal was to triple production of basic traditional crops (such as maize) by using fertilizer obtained entirely on farms. The amount of organic matter needed to restore the soil was estimated at 22 tons/ha/year. The green-manure crops develop well in poor soils, produce more than 35 tons/ha, prevent weed growth, reduce tillage practices by 75%, and can fix up to 150 kg N/ha.

*The Program made small farmers aware of three options for intercrop management of green manure: (1) not allowing the intercrop's growth to suffocate the maize; (2) incorporating it into the soil; and (3) using it to control weeds. It was suggested that the legumes *Canavalia* and *Stizolobium* be planted after maize, a practice that was not effective with the latter legume. Farmers contributed their own experiences by planting the legumes and maize simultaneously and controlling legume growth by pruning. Although the best method for managing green-manure crops is yet to be determined, results are promising and have been reflected in increases in soil organic matter content and resistance of crops to drought. More than half of the farmers participating in the Program indeed tripled maize yields to 2550 kg/ha.*

What is interesting about new technologies is that farmers adopt and modify them according to their own needs, after having seen and understood their advantages within farmers' value systems. However, the problem of green-manure technology is that its results are not evident in the short term; therefore, it is recommended that small farmers do small-scale experiments first with any organic matter (animal manure, legume leaves) with high N content, in order to better understand the advantages of green manure.

The Program's extension activities are done by local farmers who have increased their agricultural production. They are the people who are best trained to understand the needs, the way of thinking, and the value system of their neighbors, and who have a high degree of credibility among the poorest farmers, to teach them the advantages of using this technological innovation. A competent extensionist farmer can do an excellent job.

The Program has achieved the following results: constructing retention barriers or irrigation channels to control erosion (603 families); experimenting with minimum tillage (583 farmers); planting green-manure crops (more than 300 farmers); and increasing crop yields, with a subsequent increase in farmer income through harvest sales.

Farmer-to-farmer extension was more effective and economical than professional extensionists. Extension work was at the same time research, with farmer participation. Systems of green-manure management during periods of fallow or drought need to be developed, along with more research on agroforestry systems.

Reorienting research on hillside agriculture should take advantage of the ability of small farmers to identify and measure technologies. Therefore, the way in which the farmer does research, sets up methods for comparing trials replicated among small farmers, integrates investigations with trial and error, and develops related statistical methods should be studied. In addition, the orientation of training programs for highly motivated farmers should be defined, scientific language should be made accessible to farmers, incentives that encourage farmers to do research within a broader outline should be identified, and a way to present farmers' research at scientific conferences should be found.

Working Groups

The audience split into three working groups on the basis of the participants' geographic origin: Guatemala-El Salvador, Honduras-Nicaragua, and Costa Rica-Panama. Delegates from regional and international agencies spread throughout these groups maintaining a balanced representation in each.

The workshop objectives served as terms of reference; and a systemic hierarchization of intervention levels (from crop to watershed) for research and development in sustainable agriculture served as the conceptual frame for the discussions.

Honduras-Nicaragua

This group emphasized its concern about the large extent to which resources and the environment are already degraded in the region. It

acknowledged, however, that the above case studies gave reason for hope, even though the area covered by the studies was small.

The group produced a list of problems affecting sustainable agriculture on the hillsides, namely: "resource deterioration; loss of knowledge on hillside management; underestimation of resources; extensive ranching; little technology adoption; and lack of massive participation".

There was a consensus that presently used technology is deteriorating the resource base, and that, consequently, the group should focus on the poor adoption of improved technology. A list of 14 causal factors included technology inappropriateness (for social, economic and ecologic reasons); faults in the research-technology transfer system (disjointed components, lack of farmers' participation, wrong diagnoses); lack of communication among the various players; and faulty policies.

The group chose green manure for maize production in Nicaragua and Honduras as the specific focal point for its discussions, concluding the following:

- * International agricultural research centers (IARCS) should do strategic research on relevant regional problems, such as biological nitrogen fixation and soil microbiology. The NGOs and national programs (NPs) should do applied research, with NPs and universities also moving toward strategic research.
- * IARCs should coordinate their in-country activities with NPs and NGOs. NPs are seen as facilitators and coordinators, roles which may be fulfilled with good will, even in the dearth of actual resources. A climate of mutual respect among NGOs, NARS and IARCs is expected to prevail.
- * The group emphasized the need for interinstitutional coordination and mutual complementation. No consensus, however, was reached on mechanisms, except to improve communication through meetings, information banks, and networks. No new structures should be created, but innovative use of existing ones should be made instead.
- * To follow-up on the workshop, the group suggested that national and regional forums be implemented.

Guatemala-El Salvador

The group recognized the multidimensional character of the sustainability of hillside agriculture. The group's discussion focused on the "production of food grains on hillsides and the deterioration of soil and forestry resources".

Public, private, nongovernmental and international institutions operating on the hillsides of Guatemala and El Salvador were analyzed in terms of (1) whether they engaged in research, extension, training or natural resources management, and (2) their intervention levels, whether at crop, farm or watershed level.

The existence of a large number and a great variety of institutions was recognized. They varied, for example, in their institutional mandates, legal framework, organizational arrangement, collaborative attitude, and intervention level. Most institutions concentrate their activities at the cropping and farming-systems levels, whereas few address watersheds or ecozones. The group acknowledged the need to address these higher levels, and that this will require increased interinstitutional collaboration, which, however, is also needed at lower levels.

The group recognized a need to improve the research-extension linkages, as well as to generate technology appropriate for poor, small-scale, hillside farmers. The group also thought that the training of professionals for sustainable hillside agriculture may require changes: although disciplinary specialists will continue to be necessary, a more holistic approach should be adopted.

Interinstitutional collaboration was thought to be limited by institutional mandates, short-term agendas, a reductionist professional training, lack of communication, lack of joint planning, uneven strengths, lack of participation, and centralization.

Opportunities for collaboration were felt to be essentially symmetrical with these constraints. There is scope for liberalizing the institutional mandates, especially through interinstitutional projects with NGOs and formulations developed on a "bottom-up" basis. There is room for developing public awareness of the urgent need to address sustainability issues, and of the long-term nature of these issues. Professional training should foster inter-disciplinary attitudes and an understanding of small-farmer logic.

Communications and information flow can be enhanced by public awareness activities, networking, and publications. Institutions can be strengthened on the basis of their comparative advantages. There is scope for their democratization and decentralization of operations.

Other constraints to interinstitutional collaboration mentioned were mistrust, institutional sectorization (e.g. relevant institutions located in different ministries), competition for funds among NGOs and faulty methodology.

Costa Rica-Panama

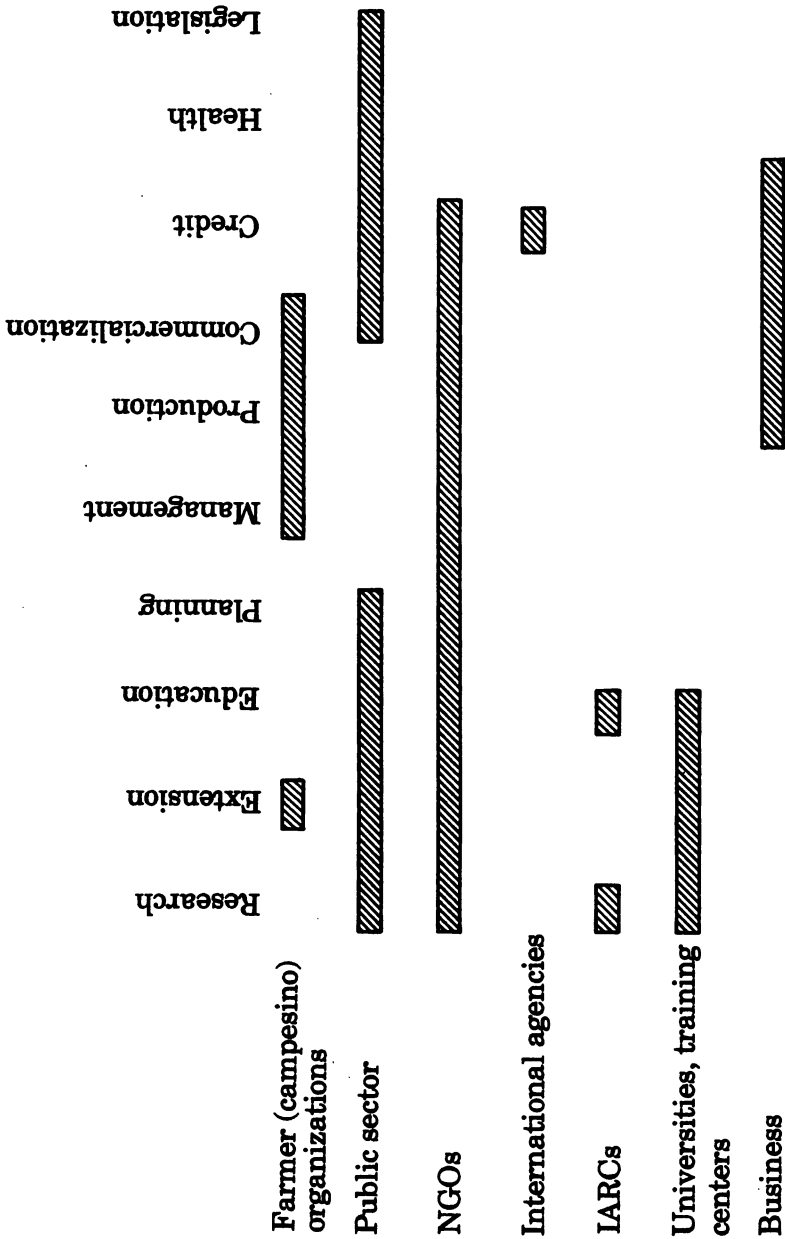
This group focused on interinstitutional relations at the watershed level, addressing biophysical, productive, social and political aspects.

The group first prepared a matrix of institutions by function with the following vectors: (1) campesino (small farmer) organizations, public sector, NGOs, international agencies, IARCs, universities and training centers and business; and (2) research, extension, education, planning, management, production, commercialization, credit, health and legislation.

For each cell the opinion of group members was recorded on whether the institution or organization was active in a given function, and whether this activity was increasing or decreasing. In the group's presentation, however, it became evident that the second aspect was ambiguous: the dynamic component was interpreted either as actual trends, or as a question of whether the institution or organization should increase or decrease the given activity.

In summary, according to the group, small-farmer organizations participate in extension, management, production and commercialization; the public sector is active in research, extension, education, commercialization, credit, health and legislation with research and commercialization seen as decreasing; NGOs participate in all functions except health and legislation (and their participation was seen as increasing or as desirable to increase); international agencies participate in financial aspects; and so forth (Figure 1).

The matrix (Figure 1) also allows the identification of coordination needs or opportunities among the various actors participating in a given activity. For example, in research there is scope for coordination among the public sector, NGOs, IARCs and universities; in extension there is room for coordination



28 **Figure 1. Institutions/organizations and their functions in the Central American hillsides.**

among campesino organizations, the public sector, NGOs and universities; and so forth.

The group then prepared another matrix of institutions and organizations (using those of the first matrix) by constraints and opportunities for addressing sustainable agriculture issues.

The two matrices were presented more as a methodological contribution than for their content produced during the workshop, recognizing the need to do actual diagnostic work in specific watersheds to develop interinstitutional collaboration.

The group also put forward a series of elements to be taken into account in developing interinstitutional collaboration on sustainable agriculture at the watershed level:

- * Sustainability can be discussed from various angles, such as the well-being of a growing population (in a country, region, or the world); or the production within a watershed, farm or crop field.
- * There is a hierarchy of institutional entities working at various levels. Linkage across levels is necessary; and not all entities have to act at all levels.
- * For the sustainability of a population's well-being, not all subsystems need to be sustainable, provided that the loss of certain nonrenewable factors can be compensated by means of renewable ones.
- * Policy objectives are economic efficiency, equitable distribution and security. "Conservation" is only a means to the end of long-term efficiency and equitable distribution among generations.
- * The political framework determines the environment for collaboration by:
 - assigning priorities for action;
 - establishing incentives;
 - legislating;
 - promoting interaction, and establishing and funding coordination processes.

The group concluded that the various institutional entities are increasingly interested in addressing sustainability at the watershed level. The group stated that watershed management does not refer only to water management but also to the biophysical, social, economic and political dimensions which concur on sustainable agriculture.

Plenary Discussion and Conclusions

The presentations of the three groups were discussed in plenary session and summed up by the organizing committee as follows:

- * There are levels of intervention that span a continuum, stretching from a local level, encompassing mainly biophysical components and relations, to a more global level, encompassing biophysical, social and economic aspects as well as policies. These levels are strongly interrelated.
- * To fully address the sustainability of agriculture, the whole spectrum of levels has to be dealt with. Intervention at every single level may be necessary, but only through vertically integrated intervention across levels can the goals of sustained agricultural development be achieved.
- * On the institutional side, there exists some degree of specialization by intervention level. Some institutions address mainly the more local levels, others intervene at the higher levels, while others act anywhere in between. However, some institutions also are active at more than one level.
- * There is need, and scope, for interinstitutional collaboration within "horizontal" levels, and "vertically" across the spectrum of levels.

Proposed Actions

In accord with the previous model, actions aimed at both horizontal and vertical integration were proposed.

At the horizontal level it was proposed to:

- Prepare an institutional database;
- Support institutional development (methods, management, funding strategies);

-
- Discuss activities and to share and exchange information;
 - Identify opportunities for collaboration.

No new structures, however, are to be created for these activities. Rather, existing ones are to be used and strengthened to this end, for example, the Regional Network for Cooperation in Agricultural and Natural Resources Management Education and Research (REDCA in Spanish); or the Central American Cooperative Program for the Improvement of Food Crops and Livestock (PCCMCA in Spanish). Specifically, the plenary suggested increasing the representation of NGOs in REDCA, and establishing a section of sustainable agriculture in the PCCMCA.

For vertical integration two activities were proposed:

1. Integration at the watershed level will be pursued through interinstitutional projects. For this a highly participatory process will be followed to:

- Establish site selection criteria;
- Select sites;
- Define objectives;
- Plan activities;
- Assign responsibilities;
- Design interinstitutional mechanisms.

2. Integration of the technological and production level with that of policy and political decision making. To this end, the CCAD's (Central American [presidential] Commission for the Environment and Development) sponsorship of an integration workshop will be sought.

Follow-up

To follow-up on the proposals, the organizing committee of this workshop (CATIE, CIAT, CIMMYT, IICA), at the plenary's request, will continue functioning as a working group for sustainable agriculture in Central America. Its membership will be expanded to incorporate two representatives of NGOs from the region and two representatives from the public sector institutions.

Acknowledgment

The organizing committee is indebted to a host of institutions and persons, too many to be registered here one by one, who contributed to the successful implementation of this workshop. It wants to record, however, two particularly outstanding contributions: that of IICA's support staff at the institute's headquarters, whose highly professional performance made the organization of, and the participation in, the workshop a pleasant and fruitful task; and that of the Swiss Development Cooperation who intellectually contributed substantially to the design of the workshop, and financially facilitated its implementation.

Annexes

I. List of Acronyms Used in the Text

CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CCAD	Comisión Centroamericana de Ambiente y Desarrollo
CGIAR	Consultative Group on International Agricultural Research, USA
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
IICA	Instituto Interamericano de Cooperación para la Agricultura, Costa Rica
PCCMCA	Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios
REDCA	Red Regional de Cooperación e Investigación Agropecuaria y de los Recursos Naturales Renovables

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