CATIE

TOWARD SUSTAINABLE AGRICULTURE IN CENTRAL AMERICA: A RESEARCH AGENDA

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TABLE OF CONTENTS

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1. INTRODUCTION

After the publication of Our Common Future(12), the report of the Bruntland Commisssion on Environment and Development, in 1987, a major global awareness developed in regard to the ecological problems related to our development patterns and to the need to face them through concerted actions. The number of conferences on the subject was increased and institutions were encouraged to analyze the problems of a sustainable development, in accordance to the Brundtland Commission's call:

"The ability to anticipate and prevent environmental damage requires that the ecological dimensions of policy be considered at the same time as the economic, trade, energy, agricultural and other dimensions. They should be considered on the same agendas and in the same national and international institutions."

No doubt that when Environment and Development is the subject, the ecological dimension is emphasized and has been predominant in what today is considered as Sustainable Development(1). This ecological dimension emphasizes the conservation of the natural resource base and the environment and

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(1)The Brundtland Comission defines sustainable development as a development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.

has become an important element of numerous projects and programs at the international level. It has also influenced the creation of new programs in universities, research centers and other institutions.

Some of these programs focus on specific atpects at the commodity or farm level. For example, in several US universities the LISA program (Low Input Sustainable Agriculture) has been conceived to encourage development of agricultural practices based on a restricted use of input. Although some adverse criticism has deterred its popularity, the program seems to be making way for the concept of Conservation Biology for Sustainable Agriculture where new initiatives are being taken.

Other programs have started to focus on resource management at the region level, thus encouraging the kind of integrated inter-disciplinary work required. For example, the University of Wisconsin has created the Center for Integrated Agricultural Systems, and in Colorado State University the Center for the Analysis of the Dynamics of Regional Ecosystems (CADRE) has been established.

Whereas in the North, the ecological dimension appears to prevail in the issues related to sustainability, in the South, other dimensions are equally important. The economic and social dimension probably does not have the same significance and urgency in the North, as it does in the South. The kind of development we seek must be not only ecologically sustainable in the long term, but also economically viable in the short term, as well as socially and culturally acceptable. Also important to

our countries, because of its effect on our economies is what we may consider an ethical dimension, which reflects particularly in the concepts of JUSTICE and EQUITY in the international relations and commercial exchange.

If sustainable development is the kind of development that satisfies the needs of the present without compromising the ability of future generations to satisfy their own needs, it is obvious that the needs of the present are related to the eradication of poverty and the reinvigoration of the economic growth, as well as to the preservation of the natural resources and environment that will sustain life for the present and future generations.

From this perspective, I believe there are differences in the way sustainable development is conceived by ourselves and by the more developed countries. We have the need to accelerate our development, not just to sustain it.

This need of the South has stimulated new initiatives worldwide. The Consultative Group for International Agricultural Research (CGIAR) has incorporated the concept of management of natural resources as an important part of the research action of its associated international centers. In Central America, the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) published in 1987, at the time Our Common Future was being distributed, a Ten Year Strategic Plan for the implementation of research and teaching actions that would favour an accelerated and sustainable agricultural development. Beyond agricultural research, the sustainability concept has been incorporated into

many initiatives to promote agricultural development in different parts of the world. One of these is the Plan for Reactivation of Agriculture in Latin America and the Caribbean, that the InterAmerican Institute for Cooperation in Agriculture (IICA) has formulated.

We need to increase agricultural productivity without deteriorating the resource base. But, is that possible? The agricultural technologies used so far have not been very respectful of our natural resources. We could say that there has been a direct relationship between productivity increases of agricultural commodities and the deterioration of our natural resource base. However, we must not sacrifice productivity for the sake of keeping the resources untouched . Our challenge is to find ways to adequately manage and conserve these resources for future generations, while at the same time efforts are made to increase productivity of agricultural commodities and to improve the quality of life of our rural populations. This is the challenge that the South must face with great imagination and creativity.

We must analyze different scenarios. Some environments, like hillsides or marginal lands with low agricultural potential make productivity increases more difficult than in fertile lands. But in the latter, productivity increases quite often are obtained by the use of agricultural practices that prove unsustainable in the long term. Nevertheless, both cases constitute a challenge that should lead us to the search of new ways to manage the tropics (25) if we want to accelerate and

sustain our agricultural development. In the presence of this challenge agricultural research must play a vital role.

2. THE PREDOMINANCE OF UNSUSTAINABLE AGRICULTURAL PRACTICES

There are many examples of unsustainable agricultural practices in Central America. A brief analysis of some of their effects will allow us to see the seriousness of the problem and its consequences for sustainable agricultural development:

2.1 Devastation of tropical forests

Demographic pressure and economic trends have contributed significantly to the rapid and continuous transformation of forests to other land uses. In Central America forests are dissapearing at a rate of 400.000 ha/year(5). With these, we also lose a good deal of our genetic diversity, a wealth of the Third World that represents half of the plant genes that are utilized in the Western Hemisphere to produce medicines or to improve agricultural crops (22).

Besides the loss of bio-diversity, there is also loss of nutrients due to the burning of forests and their subsequent short-term agricultural use. A severe damage occurs by soil erosion and flooding due to vegetation clearing in the highlands of watersheds.

There is also an economic loss due to under-utilization of cut timber since part of it is burned or abandoned instead of being utilized. A recent study in Honduras shows that US$320 million worth of commercial wood is wasted annually.

We must not avoid stressing the contribution of deforestation to the greenhouse effect (global warming) by adding CO_2 to atmosphere. It is estimated that deforestation contributes between 1 and 2.6 billion tons of carbon of the 5.4 that are added annually to the atmosphere(13).

2.2 Lack of soil and water conservation practices, at the farm as well as the watershed and region levels.

Frequently we forget about watershed protection and concentrate only on practices at the farm level. In the highlands of Chiriquí, Panamá, soil is lost at a rate of 100-200 ton/ha (11) in unprotected or nude plots with 10% slope. In extreme conditions soil loss amount to more than 200 ton/ha/year. In the watersheds of Xaya and Pixcaya rivers, in Guatemala, erosion was estimated at 267 ton/ha/year. In the cotton fields of the Pacific coast, in Nicaragua, soil loss amounts to 40-50 m^3/ha/year.

2.3 Watershed contamination caused by industrial and other waste due to poor planning and management of regional resources.

2.4 Excessive and undiscriminate use of agricultural chemicals, particularly pesticides.

We have numerous examples of this harmful practice which contributes to soil and water contamination, damage to human health and destruction of natural enemies of pests, among others.

When Bordeaux mixture was used in banana production for control of Sigatoka, in the 1950's and 1960's, most of the lands later reverted to other uses by the transnational companies, were ruined by copper contamination that was toxic to almost any

other crop. In Costa Rica alone there are 7-10 thousand hectares of contaminated land[1] and a similar number in Panamá.

The indiscriminate use of pesticides cause damage to human health due to direct intoxication or to crop residues effect. In Costa Rica alone, 400-500 hospitalizations were reported annually due to intoxication between 1980 and 1985. Also in Costa Rica, lead was detected in 23 out of 24 samples of cabbage tested in 1984(10), while in 1987, 15 out of 105 samples of plant and animal origin contained higher chlorinated hidrocarbon residues than the tolerance limits established by Germany(8). In El Salvador, significant levels of these compounds were found in milk in 1981(3).

Pesticide abuse causes the destruction of pests' natural enemies abundantly found in the tropics, as well as the appearance of resistant strains to the pesticides. This usually results in the outbreak of epidemics which cause serious economic losses to the agriculture sector. In 1989, an epidemic of Liriomyza, a leaf-miner insect, broke out in the Central Valley of Costa Rica and in the Chiriquí horticultural region of Panamá. It severely attacked crops like celery, onion, potato, beets, tomato and beans, mainly. The improper use of pesticides broke the insect's ecological balance with its natural enemies and at the same time produced the pest's resistance to the chemicals.

Rothschildia orizaba, a lepidopterous, produced in 1986-87 a severe infestation of a coffee plantation in Aquiares, Turrialba, Costa Rica(16), demanding nine pesticide applications which

(1)Personal communication from Jose Galindo.

resulted fruitless and onerous from the economic and ecological points of view. Previous experiments in El Salvador, in 1967 and 1973, with Rothschildia aroma(14, 15), had shown that an outbreak of larvae was produced due to an unbalance between the insect's populations and those of its natural enemies. Parasite infection on the lepidopterous by Belvosia was very low due to continuous insecticide applications. When all chemical treatment was suspended, the populations of the pest' natural enemies increased, and in less than a year, 81% parasitism was obtained, thus solving the problem.

Just as some pests become resistant to pesticide, some crop varieties lose their original resistance to a specific pathogenic organism. In both cases a selection pressure is produced on the organism or pest which renders ineffective the treatment used, whether chemical or genetic.

2.5 The production of corn and other cereals in Central America is also unsustainable with the present level of technology. This could be solved by stopping the use of marginal lands for these crops, which in turn would affect a great portion of small farmers, or by directing research to a dramatic increase of yields and a drastic reduction of production costs. Subsidies granted to cereal producers in the North, as well as their high productivity levels make import of such cereals attractive to the Southern countries and contribute to the unsustainability of production necessary for our countries' food security.

But, is it possible to reduce costs and increase yields of crops, such as corn, in our tropical conditions? I believe that

if we learn to utilize our resource base we will find new ways to achieve this because, there might be, still, space for improving yields, particularly if we use the new technologies available at the molecular biology level (biotechnology, genetic engineering). These new technologies could be effective in costs reduction, particularly by producing varieties with pest and disease resistance, and tolerance to drought and other setbacks.

It is then obvious that we cannot keep encouraging this style of agricultural development. We need a more agressive research agenda, capable of producing impacting results in the shortest possible term, with consideration to the economical and ecological needs and of supporting the formulation and implementation of policies for the rational and efficient utilization of the natural resource base.

3. NEVERTHELESS, THERE ARE TRADITIONAL SUSTAINABLE PRACTICES

The search for a new sustainable agricultural development model requires, as stated before, imagination and creativity. It is convenient to look at some experiences in the region, because just as there are numerous examples of unsustainable practices, there are others that could be inspirational in the search for the sustainable alternatives needed by our agriculture:

3.1 The association of coffee with Erythrina, traditionally practiced in Costa Rica, is characterized by a high production, due to the fact that the leguminous tree not only provides N to the soil but also activates the absorption and recycling of P, K, Ca and Mg(6). The leguminous species also provides abundant

foliage and mulch which increases the amount of organic matter in the soil, thus improving its physical characteristics. This is an example of a sustainable agroforestry system.

3.2 The attitude towards conservation and management of natural resources that inspires some indigenous groups in Central America is particularly notable in the Kuna population of San Blas, Panamá, where the land-use practices utilized for centuries assure a sustainable use of their natural resources. Seventy two agroforestry combinations were identified in that region in a recent study(24).

3.3 Other methods traditionally practiced by many farmers in some regions include crop rotations, use of different types of organic fertilizer, mixed or sylvopastoral systems, etc. Although these experiences are in the framework of ecological sustainability, they should be a starting point in the search for sustainability in all its dimensions.

4. PRESENT RESEARCH TOWARD SUSTAINABLE AGRICULTURE

The search for a new agricultural development model has to start by reorienting research adding the elements necessary to allow a better use of the comparative advantages of the tropics. The following are some examples of CATIE's actions towards sustainable agriculture, in collaboration with the national institutions in its member countries.

4.1 Agroforestry.

Agrosilviculture or agroforestry is an alternative for the sustainable increase of the resources' productivity, particularly in small farms. Let's look at some examples:

CATIE's researchers(2) have demonstrated that the agroforestry system of Erythrina poeppigiana, a legume tree, with cocoa, and Cordia alliodora with cocoa have allowed to maintain a cocoa production of 1 ton/ha/year without fertilizer (1983 to 1988). The average in Central America is 0.35-0.45 ton/ha/year. The soil reserve of organic matter (0-45 cm) increased in ten years from 198 to 240 ton/ha with E. poeppiagiana and from 168 to 184 ton/ha with C. alliodora. This system (9) has a very low nutrient leaching (<10 Kg/ha/year), which is equivalent to sustaining a natural ecosystem. This means that a sustained production can be obtained in the long term with very low input, thus providing an alternative to low-income farmers from humid tropical areas.

Another researcher(17) showed that the legume trees E. poeppigiana and Gliricidia sepium, in an alley cropping system with corn and beans, contributed to increase and stabilize the yields of beans. In seven years of experimentation he also found a significant reduction of the deterioration of corn yields with the same system.

Studies on the relationship between cattle, guava trees and pastures(18, 19, 20) have demonstrated that the silvopastoral system provides more benefits than the pastoral system alone, just because of the additional production of firewood, fruit, and

shade, which are used by men and animals. According to one of the scientists(1), one animal is capable of eating 30 Kg of guava fruits per day.

4.2 Integrated Pest Management and reduction of pesticide use.

Integrated Pest Management is another action aimed towards a reduction and a more rational use of pesticides. In 1984, with AID/ROCAP's financial support CATIE initiated the IPM regional project. The main actions have been oriented towards promoting a rational pesticide use based on the knowledge of economic thresholds which take into consideration the critical population levels of pests which cause economic damage to crops. Analysis of pest population levels allows to take decisions on pesticide applications only when pest levels justify. During the first five years of the regional project, applications for pepper weevil control were reduced from 17 to 4.5 in Guatemala. This example is especially important considering that crop protection costs represent 50% of total production costs for crops like pepper and tomato in Central America. The number of pesticide applications on cabbage, tomato, red pepper, and maize have been reduced between 30 and 40% using economic thresholds, resistant or tolerant varieties, and in some cases, biological pesticides such as Bacillus thuringiensis.

Infection risk prediction methods for Black Sigatoka of banana and plantain based on climatic data are being developed with the cooperation of CIRAD-ORSTOM. This provides farmers with

(1)Personal communication from Eduardo Somarriba.

a system for timely application of fungicides instead of making high risk costly calendarized treatments.

Proliferation of the nematode, Meloidogyne arabicida, which causes damage to coffee in Costa Rica prompted search for an alternative to nematicide use. Some Coffea canephora cultivars were found to be resistant to the nematode(4) and show promise for managing this pest.

4.3 Conservation and utilization of Genetic Resources.

The genetic resources are among the most valuable natural resources that our tropical countries posses, but they are disappearing at a fast pace due to indiscriminate deforestation. The conservation of these resources is very important in the search for the new ways needed to manage the tropics in order to sustain and accelerate our agricultural growth and development. CATIE has a genetic bank with more than 49.000 accessions of different plant species (forest, fruit, medicinal, ornamental species, spices, roots and tubers, etc.) and some genetic animal species, particularly of criollo bovine breeds. These resources, which are available to the member countries, have a potential for the development of promissory crops for export, and also contain the genes that could, in a near future, be used by conventional breeding methods, or transformed and transferred by genetic engineering to crops that would constitute the base for our accelerated and sustainable development. Our genetic bank is constituted by a seed bank, field collections and in-vitro collections. Recently, a criopreservation unit (-196 C) has been incorporated with IBPGR's support. This method is being used for

plantain, with apical meristems and other embryo-genetic structures.

Genetic resources are basic to any crop improvement program. Until now, improvement programs have mainly used conventional plant breeding techniques. Biotechnology and other genetic engineering techniques have been hardly utilized in Central America. CATIE has recently tried some biotechnological methods on cocoa and plantain research. A successful result was obtained by *in vitro* micrografting of somatic embryos of promising cocoa cultivars on juvenile rootstocks obtained by *in vitro* germinated seeds. This method will shorten the time of the genetic improvement process and will allow a wider distribution of improved material without the loss of viability that occurs with seeds.

4.4 Management of natural forests.

In the area of management of natural forests alternatives are being studied that would allow them to be converted to a productive system. Generally, there have been two divergent tendencies in the management of the natural forest resources:

a) The traditional land use pattern with selective and destructive timber exploitation, which was often followed by a conversion of the forest land to another land use.

b) the conservationist-protectionist pattern

The alternatives offered by CATIE represent a third tendency which will allow the combination of the production, protection, conservation and restoration functions. For example, CATIE's researchers(7) propose as a management objective for a primary

forest in the Atlantic zone of Costa Rica, the sustainable production of sawn timber and plywood (minimum felling diameter 40-60 cm) as primary products, and firewood as a secondary product, by natural regeneration and maintaining the intrinsic functions of the forest. The results obtained indicate that with a relatively conservative intensity of harvesting (20 to 60% of the trees of harvestable size, which is equivalent to the extraction of around 20 trees/ha), but with an adequate supervision of skidding and transportation of logs that will permit regeneration, it is possible that the natural primary or secondary forest be maintained as a sustainable and economically attractive production system at the farm level.

4.5 Management of protected areas.

A similar work is being conducted in protected areas, reserves or national parks, including mangroves. CATIE and national institutions have initiated the establishment of demonstrative areas of conservation for sustainable development, where studies are conducted to demonstrate the possibilities of economic production with conservation of natural resources. Numerous species originated in the forest are being studied and evaluated in regard to their economic potential. Eight promissory species have been selected for study out of more than 60. This study pretends to change the use of the forest from a extraction pattern to a cropping pattern. This system would contribute to the *in situ* conservation of genetic resources. The utilization of valuable genetic resources could contribute to this method of biodiversity conservation. Conservation *in situ*

has been difficult to implement so far because of deforestation, urban developments, etc. This conservation method is important because the energy flow in natural ecosystems is not the same as in botanical gardens.

4.6 Watershed management.

In the area of watershed management, a regional perspective is used for the integrated management of natural resources with the watershed as a basic planning unit. The identification of priority watersheds in CATIE's member countries is becoming an action model that permits the integration of the perspective of resource management with that of production systems development and other land use systems that are ecologically and economically sustainable.

5. WHAT STILL NEEDS TO BE DONE

Despite all of the above mentioned efforts, I believe that the urgency to accelerate a sustainable development brings us to the need of a working methodology for technology generation and transfer that considers the integration of different disciplines' efforts in the search for solutions to problems that cannot be considered as isolated problems. We still have a long way to go. We cannot design sustainable practices, in the whole sense of the words, without a strong multidisciplinary integrated approach. Here is where many research actions presently implemented have failed. Let's look at some examples.

Several years ago(1) an international research center in Panamá implemented several actions in collaboration with the

national research institution directed to the improvement of corn and beans production systems, while conserving at the same time, the soil resource, in an area with great agricultural potential but with fragile soils due to irregular topography. An improved alternative was designed having as one of the main elements the zero tillage methodology. The participation of agronomists and economists was essential to the development of the new production systems that not only increased productivity but reduced production costs and conserved the soil. Nevertheless, the zero tillage methdology depended heavily on herbicides for its viability. This method protected the soil resource but it increased the use of chemicals that are today being seriously questioned because of their harmful contaminating effects. Maybe the addition of an ecologist or a toxicologist to the team would have anticipated some of the risks that were overlooked at that time.

Recently, a respected nematologist conducted some research in Costa Rica that demonstrated the feasibility to control the nematode Meloidogyne arabicida, in coffee plantations, by applying chicken manure, which was obtained at no cost during 1988. However, when poultry growers became aware of its properties this product started to sell at a price that has been raised from 0.20 (Costa Rica colones)/Kg in 1989, to 2.00 (C.R. colones)/Kg in July, 1990. What looked as an ecologically sustainable solution became economically unsustainable. Maybe an economist should have worked with the nematologist in this case.

Plant breeders and agroforestry experts should also join efforts and work more closely. For example, coffee breeders should be working in the development of varieties that are suitable for an agroforestry system (for example with E. poeppigiana) instead of developing varieties that are more suitable for monoculture.

Likewise, cocoa breeders should work mainly to develop superior varieties that are adapted to a system with Erythrina or Cordia alliodora, which has demonstrated its ecological sustainability.

Corn and bean breeders on the other hand should consider the ecological sustainability of alley cropping (for example, with E. poeppigiana and G.sepium), and develop varieties capable of producing high yields under such a system.

It is not enough to maintain yields stability if these are low and economically unfeasible. Only interdisciplinary, well-planned work could help us reach the desired goals. But this does not mean that practices originated in inter-disciplinary research will allow us to reach those goals if they are generated and implemented in the context of individual farms. There is a need to consider the interactions between farms and landscapes within a watershed or a particular region, as well as the management of resources in an integrated way taking in consideration the ecological, economic and social goals. There is also a need to consider the necessary policy issues to meet the requirements of sustainable development by providing the incentives that are now lacking.

In the field of agricultural policies we face an important task, as important as the generation of knowledge and technologies for the development of sustainable agriculture. That is why policies cannot be set aside when considering the need of a research agenda. The need for appropriate policies can best be described by the following examples[1]:

1- In the region of Bocas del Toro, Panama, national institutions and CATIE have been studying the possibility to combine economic production with the conservation of natural resources in a coastal humid forest. Several species have been evaluated with this purpose, among them a species that produces very high quality "heart of palm". This palm has a very good economic potential, but it is uncertain that the local farmers will cultivate this species because government policies provide incentives for cattle growing which include ample credit to finance this activity, but not yet for the development of new alternatives to promote sustainable development. In order to produce "heart of palm" and other promisory species in a sustainable way, policies should be established both to encourage its cultivation, and to protect the resource for the benefit of the local population.

2- The same concept of conservation and development has been experienced in the northern region of El Petén, Guatemala. But the situation here seems to be one of overprotection. After work was initiated on economic production combined with conservation of natural resources, the region was declared a

(1)Personal communication from Tomas Schlichter.

biosphere reserve. This has produced the fear among the population that they will be ejected or at least prevented from farming the land. Therefore, new production alternatives using species from the forest are being hindered because the settlers do not wish to risk an investment on a land whose permanent usufruct cannot be assured. In this case, lack of clear definitions regarding the land's usufruct conspire against any plans for sustainable development.

What stills needs to be done or consolidated could be summarized in the following two considerations:

1- The need to encourage mechanisms for multi-disciplinary and pluri-institutional integration. REDCA(1) is a good example of a pluri-institutional integration mechanism. Its member institutions are continuosly strengthening their cooperation and integration links. Many of its research institutions are transforming their agricultural research to face the new challenges. Some of these institutions are setting priorities in regard to their resources, and are focussing on interdisciplinary work as an essential requirement in the search for sustainable and successful agricultural alternatives. The most important achievement of REDCA, however, is that the institutions have learned to work together, complementing efforts without competing with each other. I think they have been able to respond to the

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(1)REDCA is the Regional Cooperative Network for Research, Education and Training in Agriculture and Renewable Natural Resources. It has more than 70 institutions from Central America and the Dominican Republic, which includes universities, research institutions, ministries of agriculture, natural resources institutions, etc. Because of its heterogeneity, REDCA constitutes one of the most complete horizontal cooperation mechanisms in the region by enabling the member institutions to complement efforts to approach, in an integrated way, different aspects of the same overall problem.

challenge expressed by Gro Harlem Brundtland's (12): "Perhaps our most urgent task today is to persuade nations of the need to return to multilateralism"

We still have a great task in the educational field. CATIE and the educational institutions have to strengthen their ties in order to contribute to the education of the NEW TYPE OF AGRICULTURAL SPECIALIST required by the kind of development we seek. Research cannot be transformed unless we transform education first. An accelerated and sustainable development must be planned and implemented by professionals that, besides their field of specialization and among other characteristics, have a complete knowledge of the problems in all their dimensions (economic, ecologic, social, institutional)(1), that consider essential the role of interdisciplinary work, and that, without diminishing the importance of their own specialties, are capable of imagining in a creative way the new models for sustainable development that are needed.

2- In second place, a concerted pluri-institutional action must concentrate within a regional development perspective to achieve a complementary role. It must aim to the integration of all its components (of the techniques and practices at the commodity level, of the commodities at the farm level and of the farms at the regional level) and of all the dimensions having to do with agricultural sustainability (ecological, economic, socio-cultural, institutional, policies, services, etc.) At the

(1)Rafael Landivar University in Guatemala, has recently established the Faculty of Agricultural and Environmental Sciences, thus incorporating the ecological dimension in the former Faculty of Agriculture.

research level CATIE has imagined an integrated and concentrated approach which focus on REGIONAL LAND USE SYSTEMS(21) rather than farming systems. Such approach considers the different aspects of the sustainable agricultural development problems in priority areas, regions or watersheds. These areas have been called SUSTAINABLE AGRICULTURE RESEARCH AREAS (also called pilot areas of research in sustainable agriculture). They can be defined as areas or regions within a country where research and transfer of knowledge are being conducted with a multi-dimensional integrated approach (multi-disciplinary and pluri-institutional) and an active farmers' participation. The actions are conceived and implemented within a perspective of integrated management of resources (physical, biological, economic, institutional, etc.) for the accelerated and sustainable development of a particular region.

The concerted action in pilot areas is developed in different sites or experimental and demonstrative modules (Fig. 1) whose main activity depends on their own dedication or potential, according to their specific physical, biological, sociological and other characteristics. In many Central American regions, the regional research approach to sustainable agriculture must be viewed as a process that brings together elements from the highlands, hillsides, savannas and coastal lowlands and that contains a group of interrelated experimental and demonstrative sites. Actions being implemented in the different sites are linked in one way or another and the activities managed are inherent to their commodities and farms

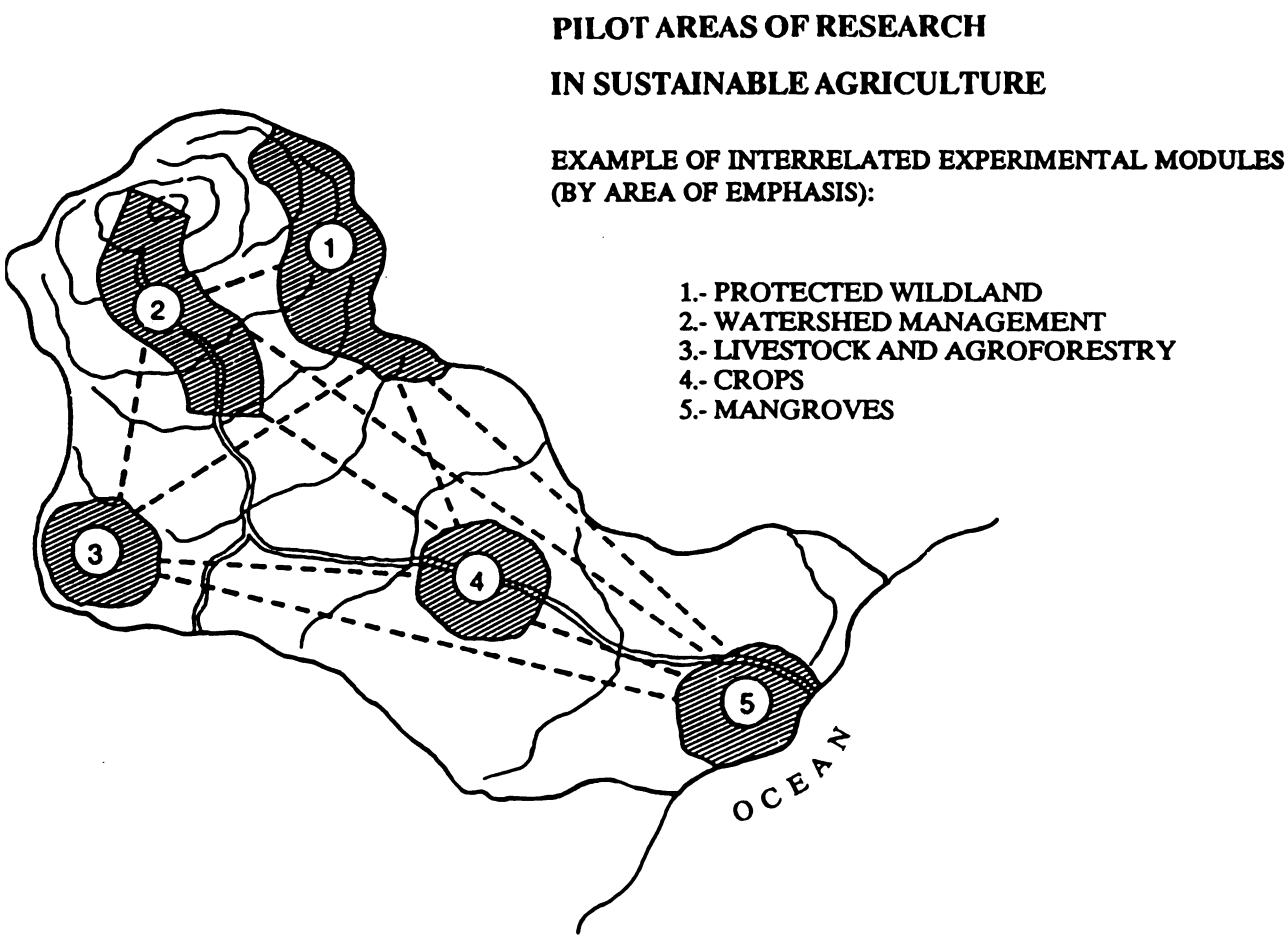

Fig. 1. Illustration of a pilot area showing different experimental and demonstration interrelated modules.

(crops, cattle raising, trees, protected areas, etc.) and to a regional common set of problems (watershed and resources management, soil and environment conservation, etc.). It is this regional perspective where resources are managed in an integrated way what constitutes the essence of the research and technology transfer actions for the development of a sustainable agriculture.

During the last year we have stepped forward in the establishment of sustainable agriculture research areas in Panama, Costa Rica, Dominican Republic, Guatemala and Honduras. This research approach has motivated a group of U.S. universities (University of Wisconsin, Cornell University, Iowa State University and Clark University), who wish to participate in this effort, complementing actions among themselves and with the local institutions, all of them REDCA members.

This collaborative, integrated and concentrated approach constitutes REDCA's answer to the challenge of sustainable agricultural development. It is a mechanism to order actions that otherwise would be dispersed and ineffective.

By organizing our actions within an integrated framework we will certainly be able to reach our goals faster. But international cooperation actions must also be organized to be able to move in an <u>accelerated</u> way. It is necessary to organize around a regional Central American strategy those projects dealing with conservation and sustainable development that are financed by several donor agencies in the region. A regional strategy for SUSTAINABLE AGRICULTURAL DEVELOPMENT should include

the concerted participation, of at least the main regional and national institutions and organizations which are presently tackling these problems. I believe that this regional strategy should take in consideration three fundamental tasks:

1- Identify priorities in regard to sustainable agricultural development, as well as the technological, economic, ecological, socio-cultural, institutional, etc. issues required for their analysis.

2- Order these priorities within a framework of regional land use systems, since they cannot be considered as isolated elements, but as closely linked components that need to be integrated.

3- Define mechanisms to insure that financial assistance really respond to those priorities and to the stated concept of development.

Sustainable agricultural development can only become a reality through a concerted complementary effort among the institutions and organizations involved. Likewise, for international cooperation to be effective and to be directed to the real and urgent needs, it must and it can work in a concerted way. However, the appropriate framework should be established to make the best use of such cooperation. The initiative must be ours.

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