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IICA

TOWARD A WORKING AGENDA FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT

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WHAT IS IICA?

The Inter-American Institute for Cooperation on Agriculture (IICA) is the specialized agency for agriculture of the inter-American system. The Institute was founded on October 7, 1942 when the Council of Directors of the Pan American Union approved the creation of the Inter-American Institute of Agricultural Sciences.

IICA was founded as an institution for agricultural research and graduate training in tropical agriculture. In response to changing needs in the hemisphere, the Institute gradually evolved into an agency for technical cooperation and institutional strengthening in the field of agriculture. These changes were officially recognized through the ratification of a new Convention on December 8, 1980. The Institute's purposes under the new Convention are to encourage, facilitate and support cooperation among its 33 Member States, so as to better promote agricultural development and rural well-being.

With its broader and more flexible mandate and a new structure to facilitate direct participation by the Member States in activities of the Inter-American Board of Agriculture (IABA) and the Executive Committee, the Institute now has a geographic reach that allows it to respond to needs for technical cooperation in all of its Member States.

The contributions provided by the Member States and the ties IICA maintains with its 14 Permanent Observers and numerous international organizations provide the Institute with channels to direct its human and financial resources in support of agricultural development throughout the Americas.

The 1987-1993 Medium Term Plan, the policy document that sets IICA's priorities, stresses the reactivation of the agricultural sector as the key to economic growth. In support of this policy, the Institute is placing special emphasis on the support and promotion of actions to modernize agricultural technology and strengthen the processes of regional and subregional integration. In order to attain these goals, the Institute is concentrating its actions on the following five Programs: Agricultural Policy Analysis and Planning; Technology Generation and Transfer; Organization and Management for Rural Development; Trade and Integration; and Agricultural Health.

The Member States of IICA are: Antigua and Barbuda, Argentina, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Kitts and Nevis, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the United States of America, Uruguay and Venezuela. The Permanent Observers of IICA are: Arab Republic of Egypt, Austria, Belgium, European Communities, Federal Republic of Germany, France, Israel, Italy, Japan, Kingdom of the Netherlands, Portugal, Republic of Korea, Romania, and Spain.

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FOREWORD

The decade of the 1980s was a critical period of transition as regards the importance given to the role of natural resources in development. Since the publication of the Brundtland Report "Our Common Future," there has been a growing awareness of the impact that current patterns of economic behavior have on the environment, as well as of the pressing need to find new styles of development that will make it possible to satisfy the needs and aspirations of current generations without compromising the ability of future generations to satisfy theirs. Sustainable development has become a key item on the international agenda, and it is appearing ever more frequently as one of the principal elements of policy and program proposals of governments and international organizations. The recently published documents "Our Own Agenda," by the Latin American and Caribbean Commission for Development and the Environment and "Sustainable Development: the Transformation of Production, Equity and the Environment," by the Economic Commission for Latin America and the Caribbean (ECLAC), are clear examples of this awareness and of the degree to which discussions have advanced on the different aspects of the topic.

This paper does not presume to propose a new option for sustainable development. Indeed, it shares the principal proposals and views of the aforementioned efforts, and represents an attempt to synthesize the issues they have raised that affect agriculture. As such, it is hoped that the paper will contribute to the discussion of the strategies, policies and actions needed to promote modernization with equity and the conservation of natural resources in Latin America and the Caribbean in the new political and economic context of the region. Furthermore, it offers some ideas on what the role of international cooperation should be in this process.

This reference document was prepared for the Tenth Inter-American Conference of Ministers of Agriculture (ICMA), held in Madrid, Spain in September 1991, by Eduardo Trigo, David Kaimowitz and Roberto Flores, Director and specialists, respectively, of IICA's Technology Generation and Transfer Program. Partici-pating in the discussions and analysis of earlier versions were: Carlos Pomareda, Enrique Alarcon, Eduardo Lindarte, Gonzalo Estefanell, Carlos Benito, Alfonso Cebreros, Tomas Schlichter, Rafael Celis, Sabine Muller and Ronnie de Camino (IICA-GTZ project), as well as other IICA personnel at Headquarters and at Tropical Agriculture Research and Training Center (CATIE). IICA would like to thank Manuel Winograd, of the Ecology Systems Analysis Group at the Bariloche Foundation in Argentina, for his collaboration, and the United Nations Development Programme (UNDP) for its support in the preparation of this document.

Eduardo J. Trigo
Director Program II:
Technology Generation and Transfer

SUMMARY

Ensuring the sustainability of agricultural production is the most important challenge on the international agenda for the 1990s. The present document outlines, from a Latin American perspective, the different dimensions involved in moving toward sustainable agriculture. Beginning with a brief analysis of the concept of sustainability, the document then examines the magnitude of the problems to be overcome in achieving sustainable agriculture: deforestation, pollution and ecological imbalance caused by the misuse of agrochemicals, the degradation of soils and the loss of genetic diversity.

The options available to the countries of Latin America and the Caribbean (LAC) for the sustainable development of agriculture are different from those open to the developed countries. The LAC countries cannot afford to restrict the growth of the agricultural sector in order to conserve natural resources. Also, they face the urgent need to reduce poverty, which, to a great degree, is the cause of over-exploitation of resources.

Because of failures in the current market system, sustainable development will be difficult to achieve without a certain amount of government intervention. However, it is not a question of abandoning the market and returning to the old style of State intervention. A first step would be to change existing policies that foster unsustainable development patterns, and then to take measures aimed at correcting the failures of the market.

In moving toward sustainable development, it will be necessary to: a) reaffirm the importance of the future and limit the use of a short-term approach; b) take a systems approach to problems; c) formulate a consistent policy framework that promotes resource conservation; d) improve inter-institutional coordination by internalizing externalities; e) develop indicators to provide pertinent information for decision making; f) develop a new technological strategy that is less harmful to the environment; g) change the human resource profile; and h) work at the local, national and multinational levels.

The basic commitment must, of course, be made by each individual country. Nonetheless, in the short term, it will be necessary to study and discuss the issue, mobilize broad-based support and achieve the minimal political commitment needed to begin bringing about desired changes. This is an area in which international technical cooperation can make a major contribution by facilitating planning, the exchange of experiences and the development of common viewpoints regarding work to be undertaken at the regional and subregional levels.

1

INTRODUCTION

Environmental conservation, improved management of natural resources and long-term sustainability in agricultural production are critical challenges on the international agenda for the 1990s.

These concerns are not new to humankind. Indeed, these issues have posed problems for governments throughout history, as evidenced by the fact that even in ancient Athens, erosion was considered a threat to survival. Today, however, because of the extent of the problem, the issue of natural resource conservation has taken on a different level of urgency.

At present, most of the planet is populated, and in many regions demographic pressure, combined with the existing forms of production and predominant patterns of development, have exceeded the limits of sustainability. Furthermore, current projections show that the world population will double by around the year 2025. This means that, in order to maintain food supply at current levels, when nearly a billion people are already living in extreme poverty, the production levels achieved by mankind over the last 12,000 years of evolution must be doubled in the next 40 years.

Moreover, we are already witness to many cases of environmental deterioration resulting from poor soil management and overuse of the natural resource base. The case of the Sahel in Africa, the destruction of forests by acid rain and the desertification of many areas of the world, as well as the drop in productivity caused by poor soil and water management and the excessive use of agrochemicals, clearly show how widespread the problem is. The same applies to massive deforestation in Latin America, the problems caused by pollution and toxic waste, overgrazing and the loss of genetic diversity. Mismanagement of natural resources is today the rule rather than the exception.

It is also important to call attention to the international dimension of environmental degradation. In addition, we now have access to improved and more detailed information on the nature of the problems. This enables us to better anticipate the probable effect of specific actions, and to design alternative courses of action and strategies that can halt and even reverse the processes of deterioration.

As a result of all these developments, the issue of sustainability and judicious resource management has become increasingly important and is one of the main items on the national and international political agendas.

In this paper, we offer some thoughts on the various dimensions of the transition to sustainable agriculture, from the Latin American and Caribbean (LAC) viewpoint, which does not conflict with the viewpoints of other regions of the world, but does emphasize the

development requirements of this particular region and underscores the responsibilities of all those directly or indirectly involved in the process. In Chapter 2, we briefly discuss the concepts of sustainability now in use in different organizations. In Chapters 3 and 4, we provide information on the scope of the problem in the region and then discuss the relationships between sustainability, poverty and agricultural growth in LAC. Chapter 5 discusses market failures and the type of public intervention needed to achieve modernization with equity and natural resource conservation. Chapter 6 analyzes certain issues that are fundamental in achieving sustainability, such as a reaffirmation of the importance of the future, the use of a systemic approach, and the need to bring about changes in policies, institutions, the indicators used, technological patterns and human resources. It also examines economic opportunities presented by a greater concern for the environment. Finally, Chapter 7 proposes some specific points that should be included in a strategy of action for achieving sustainable agricultural development in the short, medium and long terms, as well as steps that can be taken by individual governments and by the inter-American system to attain these goals.

2

THE CONCEPT OF SUSTAINABLE AGRICULTURAL DEVELOPMENT

In practice, it is just as difficult to define "sustainability" as it is to define "development." Thus, the lack of a precise and objective definition for developing clear working guidelines is one of the first difficulties that must be overcome in the effort to elaborate a strategy of action for sustainable development. Indeed, the concept of sustainability implies a certain approach or perspective —a general outlook on the basic fabric of society— rather than a specific set of actions to be undertaken, either by individuals or by public and private organizations, within a given society. Hence, when we speak of sustainable development, we must reconcile economic and social issues with the biophysical dimensions of natural-resource management and the capacity of the different ecosystems to respond to the demands of society (Girt 1990).

Many attempts have been made to arrive at a working definition of sustainability; essentially, however, all of these definitions concern the relation between natural resource reserves and the increasing per capita consumption of such resources and, consequently, the need for greater attention to natural-resource management as part of those decision-making processes affecting economic growth and development. Societies and ecosystems are continuously evolving. Therefore, the issue is not whether or not changes should take place, but rather the speed and magnitude of those changes: current rates of development are exerting strong pressure on ecological, economic and social systems. Sustainable use and conservation of natural resources should thus be seen as a dynamic concept; the objective should not be to "freeze" species or ecosystems, but rather to ensure that it is possible to continue evolving. On this matter, the Brundtland Commission links satisfaction of needs with generational continuity (present to future), seeing the whole as a process of change in which the utilization of resources, the direction of investments, the orientation of technological development, and institutional change are harmonized and channeled towards improving present and future capacity, in order to satisfy the needs and aspirations of mankind. In our view, this is the most useful way to approach the problem and to develop strategies for achieving sustainable development.

SUSTAINABLE DEVELOPMENT

...is the management and conservation of the natural resource base and the orientation of technical and institutional change in such a way to assure the continuous satisfaction of the needs of present and future generations.

FAO

...should combine the planned use of resources used in agricultural production with efforts to maintain or strengthen the existent resource base so as to prevent environmental degradation, in order to satisfy the changing needs of society.

CGIAR

...refers to the use of biophysical and economic resources to obtain products whose current socieoeconomic and environmental value represents more than the value of their inputs, while at the same time protecting future productivity of the biophysical environment.

R. Hart

...is intended to ensure that present generations are able to meet their needs without jeopardizing the ability of future generations to meet their needs.

Brundtland Commission
Our Common Future

...is equivalent to economic change subject to the constancy of the natural stock.

D. Pearce

...is the persistence, over an apparently indefinite future, of certain necessary and desired characteristics of the socio-political system and its natural environment.

J. Robinson *et al.*

3

THE DIMENSIONS OF THE PROBLEM IN THE REGION

As far as the aggregate picture and statistics are concerned, the outlook for LAC as a whole as regards resource availability is relatively good. With only 8.1 percent of the world population, the region has 23 percent of all potentially arable land in the world, 12 percent of all the cultivated land, 17 percent of the rangelands, 23 percent of the forests, 46 percent of the tropical forests and 31 percent of the runoff water with a potential for stable utilization. It is also one of the most genetically diverse regions in the world -about 35 percent of the varieties of the 20 main food and industrial crops originated in the region— and only a very small portion of this diversity is currently used (particularly in the tropical areas, where it is estimated that small tracts of Amazon forest, for example, contain more plant species than in all of Europe). The region also has around 3 percent of the world's oil reserves and 19 percent of its hydroelectric energy potential (Gallopin 1989).

These aggregate figures, however, do not reveal the enormous differences and trends that exist between different countries. Far from being encouraging, these differences show the need for immediate and profound changes to be made in the organization and performance of agriculture in the region. In some of the countries, the ratio between population and resources is critical, and there is little chance that by the year 2000 they will be able to support their populations with their own agricultural output. Although the availability of arable land is not a limiting factor at the overall level, in some areas such as Mexico, Central America and the Caribbean, a very high percentage of the land suitable for farming is already in use.

Moreover, the rate of deforestation in the region is extremely high and on the rise in recent years; it is estimated that during the last five-year period, some 50,000 km^2 per year were deforested, i.e., an area equivalent to the total area of Costa Rica or the Dominican Republic. We have seen around 2 million km^2 of forests (an area greater than that of Mexico) cut down since 1960, with most of this activity taking place over the last few years. According to some estimates, around 4.4 million hectares of natural ecosystems, 78 percent of them in tropical areas, have been affected every year. Between 1980 and 1985, losses were calculated at around 17.5 million hectares in tropical and subtropical humid forests, 2 million hectares in mountainous regions and around 8 million in tropical and subtropical dry forests (Gallopin 1990; UNEP 1990). Independently of what these processes may mean in terms of poor use or misuse of a highly productive resource, they also threaten the long-term viability of a large number of watersheds that are strategically important for the food security of some countries. Likewise, massive deforestation has a serious impact on genetic diversity. According to some estimates, every hectare of tropical forest may have between 1,000 and 2,000 plant species, 250 of which are trees. Because so little is known about the genetic makeup of these ecosystems, the destruction of a small area of tropical forest can represent the disappearance of a number of both

plant and animal species whose possible benefits may never be known. Although it is very difficult to determine the specific impact of these processes, the fact that at present approximately 50 percent of the increases in plant yields have been made possible by genetic manipulation gives us an idea of the strategic importance of germ plasm resources and the impact that the loss of genetic diversity may have on agricultural development. Furthermore, the cultural heritage and empirical knowledge of indigenous peoples and peasant farmers is being lost faster than are biotic resources. Achieving sustainability in land use and natural-resource management in certain areas (tropical forests, mountainous regions, lands subject to flooding) involves recovering, understanding and incorporating those peoples' technologies and land-use systems. Often they have been able to overcome problems and exploit resources with their own technology where modern science has failed or is in its infancy (Winograd 1989; Gallopin and Winograd 1990).

The large-scale and growing use of fertilizers and pesticides is polluting water sources and giving rise to toxic residue problems in crops, with residues often exceeding the maximum levels allowed for human consumption (Gallopin 1989). Excessive use of pesticides has also given rise to mutants and more resistant species of pests, as well as the proliferation of new pests, due to the eradication of natural enemies.

INCREASE IN TOTAL ENERGY CONSUMPTION

Between 1965 and 1988, regional energy consumption increased significantly. Per capita petroleum consumption, in terms of kilograms (kg) doubled during that period in countries such as Colombia, Costa Rica, Haiti, Honduras and Mexico, while in Brazil, Dominican Republic, Ecuador, Panama and Paraguay it almost tripled. Thus, Brazil's consumption jumped from 286 kg per capita in 1965 to 813 kg per capita in 1988. In Panama and Ecuador, it grew from 576 and 163 kg per capita in 1965 to 1627 and 573 per capita in 1988, respectively.

In the case of agriculture, although exact data are not available, the consumption of fertilizers is a good indicator of total energy use. In Colombia, per hectare consumption of fertilizers climbed from 28.7 to 94.5 kg between 1970 and 1988. In Guatemala, Mexico and Venezuela, fertilizer use increased 2.2, 3.2 and 9.3 times, respectively.

This reveals the growing dependence of agriculture on energy-intensive fertilizers due to the spread of economically important crops which require ever greater amounts of nutrients. It also shows the loss of productivity caused by soil degradation and the loss of fertility attributable to improper agricultural practices.

Source: World Bank 1987, 1988, 1989, 1990

At the same time, desertification is advancing at an alarming rate, particularly in rainfed ecosystems, where almost 70 percent of the area has already undergone same degree of

GENETIC DIVERSITY IN LATIN AMERICA AND THE CARIBBEAN

Genetic diversity is one of Latin America and the Caribbean's most important, yet least exploited, strategic resources. The region is host to more than 40% of all known plant and animal species of tropical forests, more than in Africa or Asia. In Costa Rica alone, there are more species of birds than in all of North America, and several forests in tropical America contain more plant species than all of Europe. It is estimated that there are more than 30,000 species of higher plants that have known uses in medicine, for wood and other industrial or food products, and the economic potential of most of the species has still not been evaluated. Up to now, only 10% of the plant species in the world, and 1% of animal species, have been submitted to a "preliminary" examination to determine their possible medicinal or commercial applications. Moreover, in the future, new biotechnologies and other technological break-throughs will make it possible to use many species not used at the present.

Colombia, with 0.77% of the earth's surface, hosts 10% of the world's plant and animal species (26% of the birds, 15% of the orchids). Brazil, with 6.5% of the earth's surface, contains 22% of the world's higher plants. Of the 250,000 higher plant species identified to date, at least 90,000 are found in the region. If we consider that at least 10% of these species could be used for medicinal purposes, 10% for industrial purposes and 15% for food, approximately 31,500 species with potential use exist in tropical Latin America.

As a result of deforestation, loss of natural habitats and indiscriminate hunting, the number of wild animal and plant species can be expected to decline sharply. It is estimated that over the next forty years between 100,000 and 350,000 species may disappear from the dense tropical forests of the region. A moreover biodiversity is not simply a matter of the number of animal and plant species; it also includes the diversity of environments and ecosystems. For example, in Puna (an area ranging in altitude from 3,000 to 5,000 meters), for every increase of 100 meters in altitude, the temperature drops 0.5°C, with concommitant changes in vegetation and climate. This provides for a wide variety of conditions for different types of productive activities. Thus, certain crops and animals can be raised in Puna which have no competition on international markets; for example, camelidae (llama, alpaca, vicuña), whose yields and prices are higher than introduced varieties. Some 200 varieties of potatoes and 31 other crops (grains, legumes, fruits, nuts, etc.), with high yields and high nutritional value, also grow in the zone. Unfortunately, there is a noticeable trend toward reducing the number of varieties planted, focusing only on those for which there is a good market. This type of situation will lead to a rapid "erosion" of genetic diversity and, consequently, the destruction of one of the most important comparative advantages of the region. In the future, when new sources are sought for pest resistance or for producing new medicines or oils for industrial use, it may very well be that the species or variety will no longer exist.

Source: Commission on Development and the Environment in Latin America and the Caribbean 1990; McNeely *et al.* 1990; NAC 1989; Rapoport 1988; Winograd 1989

degradation. Erosion in the mountainous ecosystems of the Andean zone and Central America affects an estimated 40 to 60 percent of potentially arable land. According to some calculations, in the early 1980s, more than 2 million km^2 in the region as a whole suffered from moderate to severe erosion. Overgrazing degrades natural pastures and their capacity to support livestock, and in turn creates pressure to clear forests. This is especially true in tropical areas, but it also occurs in subtropical and temperate zones, such as in the pampas of Argentina, where a significant decline has already been noted in the production of natural fodder. In many areas, sedimentation, salinization and alkalinization resulting from the mismanagement of irrigation systems have significantly reduced productivity.

SOIL DEGRADATION IN THE HUMID PAMPAS OF ARGENTINA

Agricultural and livestock activities in the Humid Pampas of Argentina developed as a mixed production system, which involved rotating cattle grazing on pastures of legumes and grasses with annual crops, especially cereals. Under this system, livestock activities replaced the fertility consumed by agriculture.

Over the last two decades, this system has undergone a major change with the onset of "permanent agriculture." This involves sharply expanding cultivation of oilseeds, especially soybeans, instead of corn and grain sorghum. The absence of soil conservation practices in this new system has accelerated soil degradation. The principal causes of this phenomenon, which has reached major proportions, are soil compactation caused by machinery used to more intensely work the soil; the limited amount of organic material incorporated into the soil after the soybean harvest; and the organization of production around short-term tenant farming contracts; tenant farmers have been reluctant to introduce conservation practices. In some areas, generalized physical degradation has led to loss of organic material and structure and to percolation in agricultural lands which is more than 46.7% higher than in unfarmed or virgin lands. Chemical degradation, in terms of the loss of whole nitrogen and assimilable phosphorous, is 48% and 76% greater, respectively, than in virgin lands. Erosion by water, measured in terms of the reduction in the width of horizon "A," has moderately to severely affected one-third of the total land area (losses of between 5 and 20 cm of topsoil). The annual rate of soil loss is high, in some cases reaching 70 tons. In the case of the Arrecifes river basin, which covers more than 1,200,000 ha, half is affected by varying degrees of water erosion, with several centimeters of fertile soil already lost. Such degradation and erosion have made it necessary to increase the amounts of chemical fertilizers just to maintain the soils' natural levels of productivity, with the corresponding negative impact on both the environment and on profits.

Source: Coscia 1991

This situation is the result of a long-standing series of inconsistencies in agricultural policies and in agricultural institutional structures. In this context, it is clear that the prevailing pattern of production can only be maintained at the risk of totally destroying large segments of our ecological capital —forests, soils, species, water, air— thereby jeopardizing the very existence of future generations. This means that we must seek production strategies that will enable us to meet our present needs without compromising the capacity of future generations to meet theirs.

4

AGRICULTURE, POVERTY, GROWTH AND SUSTAINABILITY

In moving toward development patterns and production strategies that are more sustainable over the long term, it will be necessary to restructure consumption patterns and even sacrifice present levels of production and productivity for the sake of future benefits. The nature of the options to be considered and, indeed, the very possibility of moving toward such strategies, will depend to a large extent on the situation of each economy and on the role of agriculture in each.

The significant economic progress and high production levels of the developed world have opened up economic and political opportunities for reorganizing existing agricultural production strategies, with a view to reducing their impact on natural resources and on the environment. Moreover, in some of these countries, because high subsidies are currently applied to production, it may even be economically profitable to sacrifice output to pursue conservation-oriented objectives.

Scientific progress, for its part, has provided us with a better understanding of the overall ecology of the earth and of the relationships between different subsystems, as well as of the impact certain types of activity can have on human health and on environmental equilibrium. This has given rise to strong currents of opinion and militant political movements advocating the development and implementation of policies and actions to promote conservation and production schemes that take into account the possible impact on the environment and on natural resources. Many of these groups, however, do not have a correct perspective on the situation and the priorities of the developing world.

In the developed countries, agriculture is a minority sector, both in terms of the population that directly depends on it and of its importance to the economy. Thus, any changes made to protect and maintain the natural resource base will have only a limited impact. Moreover, the relative affluence of these economies makes it possible to offset the negative impact of the new strategies on specific sectors. In this context, extreme measures, such as setting aside land for recreational or other activities or sacrificing output and the availability of certain products, may be considered reasonable options. Indeed, this possibility has already been seen both in the strength of the aforementioned currents of opinion and in the changes evidenced in consumption patterns, which now favor the products of a more "natural" agriculture which uses minimal chemical inputs.

In the developing countries, on the other hand, agriculture is one of the principal sectors of economic activity and, in many cases, agricultural areas are home to a large part of the population; therefore, the options and possibilities are entirely different. Moreover, high

population growth rates, associated with inequitable land-tenure systems, have meant that a large portion of the poorest segments of the population frequently live in rural areas, farming marginal lands in a vicious cycle of overutilization, degradation of resources and poverty. The lack of a comprehensive view of resource utilization has also meant that forestry areas have not generated employment, nor have they been capable of absorbing the population; this has contributed further to aggravating the harmful impact of the cycle.

This problem is very evident in Latin America and the Caribbean. Although LAC differs from other parts of the developing world because of the wealth and diversity of its natural resources and its tremendous agricultural potential, it also has a very large mass of poor peasant farmers who are forced to overuse their land in order to survive. Furthermore, this widespread rural poverty exists side by side with farm systems (i.e., extensive stock-raising, lumber

AGRICULTURE IN LATIN AMERICA AND IN THE DEVELOPED COUNTRIES

Agriculture's share in the GDP of the countries of Latin America and the Caribbean (LAC) is approximately two times greater than that of the developed countries. In the poorest countries of the region, such as Bolivia, Haiti, Honduras and Paraguay, agriculture's share of the GDP is greater than 25%, as compared to 2% in the United States and Germany, 3% in Japan, and 4% in France. While agricultural and forestry products represented 29% of exports from the region in 1988, they accounted for only 12% of the exports of the developed countries.

Thirty-five percent of the population of the region lives in rural areas, and agriculture provides work for a similar proportion of the population. Approximately 102 million of these rural inhabitants are poor and many of them must engage in farming practices that harm the environment. In most of the developed countries, the percentage of the population that earns a living directly from agriculture is very small, and rural poverty is not closely linked to the problem of natural resources.

Source: World Bank 1990; FAO 1988.

companies and intensive commercial agriculture —cotton, for example) that are also damaging to the environment.

This contrast only dramatizes the nature of the challenge that lies ahead. With agriculture occupying most of the region's human and economic resources, and given the region's significant comparative advantages for many agricultural products, any development strategy to be implemented in the region must be based on the productive utilization of natural resources.

Because of the crisis in LAC, it is absolutely necessary to resume growth, and agriculture has a strategic role to play in this effort, whether in producing enough food for a growing population or the raw materials needed to tap the dynamic potential of agroindustry and timber industries, or in generating the foreign exchange needed to balance the external accounts. The challenge lies in finding a way to do all this equitably, so as to bring the currently neglected peasant farmers into the growth process, and at the same time preserve and increase the availability and productivity of the region's ecological capital and ensure that increased well–being is sustainable over the long term.

5

MARKET FAILURES AND THE REGIONAL CRISIS AS A FRAMEWORK FOR THE CURRENT SITUATION

The current natural resource situation has not been brought about by the deliberate and perverse action of individual social actions, but rather by the market's failure to send appropriate signals that would enable economic agents to act correctly, as well as by the State's ineffectiveness in designing and implementing measures to correct those shortcomings.

The present social and production structure —and, in a broader sense, the way humanity relates to the environment— is based on the belief that ecological capital (genetic diversity, soils, forests, fisheries, water, air) can be replaced by man-made capital; hence, in accordance with this way of thinking, production patterns can be designed almost without taking natural resource availability into account since human beings, in due course, can supposedly replace any resource that might be destroyed during a given production process (Pearce 1989).

There is now a growing concern over the issue of sustainability, in that there is a increasing realization that current consumption patterns cannot be maintained over time. This is due, to a large extent, to the fact that there is now ample evidence that ecological capital is not infinitely replaceable by man-made capital, i.e., it is not always possible to replace with man-made alternatives the ecological capital that is consumed in the production of goods and services. The problem is thus not strictly a price problem; the case of genetic resources perhaps best illustrates this problem (Pearce 1989).

The imperfect replacement of ecological resources with capital, together with certain inefficiencies in the market as an instrument for allocating resources, has established a pattern of behavior whereby present consumption is given priority over future needs in a "natural" response to socially established criteria considered "normal."

As market economies treat the services provided by ecological capital (flows) as free goods, this ecological capital tends to be overexploited. Two basic premises of neoclassical economic thinking are that there is an unlimited availability of natural resources and that only scarce resources have economic value. As a result, the institutional systems of capitalist economies have been little concerned with establishing criteria and mechanisms to correct this situation. Likewise, as far as the use and management of natural resources is concerned, the clear differences between the individual and social costs and benefits (externalities) further highlight the limitations of the market as a regulatory mechanism. While the topic of externalities is fully recognized in market economy precepts, they are dealt with only in situations where the external effects of production and/or consumption activities can be identified

and internalized through corrections in pricing mechanisms. Another factor that limits the usefulness of the market as a guide for natural resource use is the scarcity of information, often difficult to interpret, on the resource base and on the likely impact of different uses given to it.

In addition to these general problems, the macroeconomic crisis has created a number of financial imbalances which further undermine the usefulness of the market as an instrument for allocating resources. Sharp short-term fluctuations in relative prices, so common over the past two decades, have made arbitrage and short-term speculation important economic activities, to the detriment of longer-term production or conservation efforts.

SUSTAINABILITY AND MARKET SIGNALS IN LATIN AMERICA

Investment in long-term activities, such as reforestation, perennial crops and soil conservation, is essential for the sustainable development of agriculture. Whether these investments are made or not depends fundamentally on whether they are profitable.

Under current economic conditions, it is much less profitable to make long-term investments than it was in the past. One reason for this is high real interest rates. At the international level, these rates rose from an annual average of 2.64% between 1963 and 1973, to 5.85% between 1980 and 1989.

This means that, in the 1980s, someone who decided to invest in planting a tree that would be felled thirty years later would need to receive twice as much a return on his investment than he would have during the 1960s, for that investment to earn in the same profit as a dollar invested in an annual crop.

The sharp fluctuation of inflation levels, from year to year, has also curbed long-term investments in production. For example, in Argentina inflation rose from 210% in 1982 to 688% in 1984, dropped to 82% in 1986 and climbed back up to 388% in 1988. Similar fluctuations occurred in Brazil, Peru, Nicaragua and Bolivia and were generally accompanied by significant changes in relative prices. Because of these sharp and often difficult-to-predict fluctuations, investors seeking to reduce risks tend to invest in short-term activities that provide more liquidity. This also gives them the opportunity to move profits and capital to safer countries.

With such an uncertain future, it is too risky to invest in activities that will only pay off in the medium or long term.

Source: World Bank and ECLAC.

This situation of frequent price and income fluctuations, combined with the weakness of information systems in the region, makes it difficult to forecast economic conditions. If the future is less predictable, it is riskier to invest and there is a tendency to discount the expected

value of future income at rates that are even higher than on the market. As a result, in practice the future is ignored as a production alternative; at the most, it is discounted at an extremely high interest rate.

As far as interest rates are concerned, the debt crisis has also encouraged a growing and permanent trend to focus on present rather than future consumption needs. By pushing interest rates up, the crisis has established an irrefutable rationale in support of "resource mining" as the only viable strategy option over the short term.

The decline of the region's propensity to save, combined with the emergence of financial markets that facilitate rapid movement of capital out of LAC, are factors that have further encouraged a short-term approach to the use of natural resources and have consequently heightened the "perverse" impact of the tendencies described above.

In most cases, State intervention has also proven to be ineffective in protecting the environment and natural resources, both in terms of correcting weaknesses in market mechanisms and through direct action. Experience has shown that State intervention has often been a costly and weak instrument, one which may even have a negative impact on sustainable agricultural development. Subsidy policies with a narrow subsectoral approach, to which we will later refer, are clear examples of the limitations faced. Moreover, the critical fiscal situation in many countries of the region makes it impossible to consider direct corrective measures such as rehabilitation of degraded ecosystems, income transfers as a means to correct externalities, etc., as possible solutions.

In addition, the crisis has undermined the public sector's capacity to reflect on, and hence make provision for, future problems. Similarly, the universities, traditionally the "think tanks" of society, have been seriously weakened. Public planning agencies have lost their best staff, and planning as such has fallen into disrepute in the world of politics. All of this means that more priority is placed on the present than on the future, and underscores the inability of the market to promote a sustainable and productive management of natural resources.

From another standpoint, it is important to recognize that this situation is not solely the result of market failures and the behavior of the economic agents. Indeed, entrepreneurs and consumers are not the only ones who do not properly assess the importance of the future. The same phenomenon occurs, although for somewhat different reasons, among political leaders. This is almost implicit in democracies where poverty is widespread. Politicians are forced to give the people short-term solutions, and the only resources available to them are the natural resources which make up the country's social capital. In other words, politicians also apply a very high "discount rate" to the use of resources, and once again, this means that priority is given to present consumption over and above future needs.

In summary, the search for a more sustainable pattern of development in market economies, which is the prevailing system in Latin America and the Caribbean, should begin by recognizing that many of the problems are caused by flaws in the basic concepts undergirdding these economies. The crisis has highlighted these shortcomings and exacerbated even more the already limited effectiveness of State intervention as a corrective instrument, but cannot be taken as the main cause of the current situation.

The search for solutions, however, should not aim to replace the market as the basic instrument for allocating resources with another concept whereby natural resources and the environment are placed "beyond the price system." On the contrary, the idea is to make the market function properly within a context that respects environmental restrictions and fully recognizes the services of the environment as economic goods. A new price system must be found that correctly reflects the characteristics of the goods and services of the ecological capital and the full extent of their relative scarcity; in addition, it must be possible to make well-informed decisions on how to use the natural resources available.

THE IMPACT OF SUBSIDY POLICIES: THE DEFORESTATION OF AMAZONIA IN BRAZIL

Sixty percent of the surviving tropical forests of the world is found in area of approximately five million square kilometers in the Amazon River basin. The diversity of flora and fauna in this area is greater than anywhere else in the world. To date, approximately 500,000 species of plants and animals have been identified, and recent estimates are that there may be as many as 30 million more species not yet identified or classified.

Until the 1960s, the humid Amazon forest remained basically untouched, with only minimal human interference. This situation changed drastically in 1970 with the initiation of State-run settlement and highway construction programs in different parts of the region. These programs gave rise to a strong, large-scale ranching sector, which benefited from large fiscal subsidies that all but exonerated cattle raising from taxation and offered credit at highly subsidized rates of interest. It is estimated that nearly 75% of all investment in livestock activities in the region was financed with these subsidies.

The subsidy policies for large-scale cattle ranching of the 1970s (and to a lesser extent of the 1980s) contributed greatly to deforestation in the region, where, in the Brazilian part of Amazonia alone, some three million hectares were deforested. Ranching in this area accounts for 4.7% of the Brazilian herd, represents only 3.7% of the total output value of same, contributed 0.1% to GDP in 1981, and occupied 1% of the agricultural labor force of the Amazonia. This widespread deforestation may affect the climate of the region and the world, destroys soils that are useful for other purposes and threatens the economic potential offered by the genetic variety of the forests. Furthermore, the policies did not succeed in establishing stable and productive activity. Given the fragility of Amazon soils, meat yields started to fall because of lack of phosphorous, the compacting and erosion of soil and the spread of weeds.

Sources: Browder 1989; Fearnside 1989; Spain 1990.

6

ELEMENTS OF A STRATEGY TO MODERNIZE AGRICULTURE WITH EQUITY WHILE CONSERVING NATURAL RESOURCES

The current natural resource situation must not be viewed simply as a marginal undesired effect of existing systems of social organization. If this were so, minor corrections would be sufficient to set it on the right course. On the contrary, environmental deterioration and the degradation of natural resources are, to a large extent, inevitable consequences of rational actions taken within the prevailing development model (ECLAC 1990a). Therefore, the transition towards sustainable development will require deep-reaching changes and innovations in the region's current political, economic and social systems.

Because economic growth receives top priority in the prevailing paradigm, and because the market and the manipulation of economic variables have been used as the main —and sometimes the only— policy tools for orienting the performance of social groups, essential biophysical and moral issues have been neglected. Thus, the current development model is fundamentally unbalanced, both because of the consumption patterns it promotes and because of its impact on the distribution of the costs and benefits of growth.

Up to now, although many of the undesired effects of the current schemes have already become evident, they have still been manageable. In recent decades, accelerated economic and demographic growth, as well as the widening of gaps in society, have brought to light the basic weaknesses of the model and the increasing difficulty —or even the impossibility— of resolving the existing imbalances within the existing structure. Thus, if a new strategy is to be developed for restoring equilibrium between people and the environment, a major effort must be made to modify certain basic patterns of social behavior, as well as the type of technology used in the production activities which provide the societies in our region with the means of survival. Such an effort cannot be dealt with in isolation from what is taking place in the rest of the world; on the contrary, it should be circumscribed by the global context of change occurring in the use and management of natural resources worldwide.

In the following paragraphs, we discuss certain issues from the standpoint of Latin American and Caribbean agriculture. When considering alternative courses of action, however, we must recognize that while the countries of the region have much in common, there are also significant differences between them in terms of geography, population, poverty and food security, as well as of the importance of certain ecosystems in the context of the global environment.

Reaffirming the importance of the future as a point of departure for the new paradigm

The emphasis on economic growth as the basis of development is at the root of the problem of sustainability, especially as mankind is coming close to "fully occupying" the global habitat. Under the prevailing paradigm, well-being is associated with the availability of physical goods; hence, the per capita product and its growth rate are used as apt measures of the effort a society makes to provide for its members. Examples of this outlook abound, as do situations in which policy failure and the downfall of governments can be directly associated with their inability to generate high rates of growth. Nevertheless, although there is no doubt that well-being depends on the availability of physical goods, other factors, when taken together, may be even more important. These factors include environmental resources in the broad sense (space, energy, attractive scenery, clean air, animal and plant species), leisure time, income distribution (in other words, access to goods and opportunities), job opportunities and working conditions, as well as a minimum level of security about the future, insofar as this a key factor determining our behavior with regard to scarce goods and hence, our level of well-being. If we want to move towards sustainable and more equitable development within and between generations, we must stop automatically interpreting production increases —as measured in estimates of national income— as improvements in the level of well-being of a society and of its economic success. We must also replace the criterion of economic growth as the only basis for analyzing the appropriateness of specific policies and actions.

Deterioration of the natural resource base is not an inescapable conse-quence of human progress, or of population density, but rather a characteristic of a type of economic growth that is intrinsically unsustainable in environmental terms, and both inequitable and unjust in social terms (Gallopin *et al.* 1990). Environmental degradation is a consequence not of development, but of a particular pattern of development; therefore, a change of direction is necessary. The solution is not to restrain development, but to alter the model qualitatively and quantitatively, having as its central objective to improve the quality of life, rather than to achieve growth or production increases (Gallopin and Winograd 1990).

Even in contexts where economic growth is a valid indicator, a temporal dimension must be added. Achieving growth at present, to the detriment of the production capacity of the future, is not the same as achieving sustainable growth. It is not a question of eliminating growth as a measure of the development model, but rather of including with the criterion of growth both temporal and social considerations. In other words, the aim will be to replace the current growth "ethic" with an ethic that also takes into account the dimensions of equity and sustainable natural resource management. This is absolutely essential if we are to develop a strategy that will foster a style of modernization that is equitable and resource-conserving, and that will serve as the basis for political alliances, as well as of explicit and implicit long-term agreements between the State and diverse social forces concerning policies and institutional and technological innovations required to implement this strategy (ECLAC 1990a).

The need for a systemic approach and for recognizing interdependence at all levels

The problems of sustainable development cannot be understood and resolved if their different dimensions are considered in isolation from each other. Although each component of what we call the ecological capital has its own identity and dynamics, they are all parts of an interconnected and interdependent whole. Political, economic and ecological considerations are closely interrelated at all levels –local, regional, national and global– in a complex network of cause and effect in which it is difficult, if not impossible, to establish clear and accurate boundaries. The multidimensionality and interdependence of systems (biophysical, political, economic and social) are the basic concepts to be used in analyzing the issues and designing possible solutions (Brundtland 1989).

Excessive soil use and the destruction of forest reserves are problems that clearly affect production and have obvious biophysical implications, but they do not originate, and consequently cannot be solved, at that level. The increasing demand for wood products, meat and seafood, for example, in the developing countries cannot be ignored as a driving force behind deforestation and the degradation of natural resources; these processes will be difficult to reverse unless the pattern of demand changes. In most cases, these problems are a reflection of price levels, incentive schemes or the pressure exerted by a constantly growing population whose only means of survival is to farm in marginal areas. The network of interrelations becomes a complete circuit if we acknowledge that, for all practical purposes, the only viable way to control population growth is to eliminate poverty.

Thus, in many cases the most efficient solution is not to be found in direct action at the source or location of the problem. A good example is the case of overpopulation in marginal areas, where the need to produce food gives rise to a vicious circle of poverty and resource deterioration. In this case, the solution is not to develop new technologies for use in resource-poor areas, but rather to adequately organize production and optimize output in better endowed areas and to develop alternatives that will provide the entire population with access to the food they need, and to development opportunities. Clearly, this would require investments that in many cases are beyond the reach of governments because of the fiscal situation brought about by the debt crisis.

A recognition of the systemic nature of the problem and of the inter-dependence of factors does not mean that direct action for dealing with a specific problem may not be the essential ingredient of any given strategy. In the final analysis, resource conservation and sustainable development will depend on the initiatives taken at this level and the determination of the people directly concerned to cooperate and undertake comprehensive action that takes into account the social, environmental, economic and technological factors. Commitment at the local level, however, must be supplemented with action at other levels (policy and institutional) to ensure that local efforts and sacrifices bring benefits to society as a whole and are not transferred to other levels, sectors or countries.

Since the systemic nature of the problem of sustainability and conservation involves all the inhabitants of the planet, it must be dealt with as a high-priority challenge for both developing and developed countries. While there is great diversity in each group as concerns

SOLVING PROBLEMS AT THE SOURCE: PLAN SIERRA IN THE DOMINICAN REPUBLIC

The Yaque del Norte River Basin is one of the most important sources of energy and food in the Dominican Republic. The Tavera hydroelectric dam is located there and provides electricity to Santo Domingo. The Central Valley, a very fertile agricultural zone that benefits from a good irrigation system, is also located in this area. Nevertheless, the dam and the irrigation ditches are threatened by sedimentation and flooding from the rivers. Currently, sedimentation in the Tavera dam is three times greater than it should be, and has lead to the closing of another nearby dam.

The root of the sedimentation problem is found upstream from the Yaque del Norte River, in the deforestation and erosion of the Sierra hillsides, north of the central mountain range. Originally, the Sierra was an area covered with pine forests, but as a result of many years of feeling trees to grow crops and for firewood, construction materials, and furniture, by mid-1970 90% of the zone had been deforested and 70% of the land was severely eroded. The government tried to stop the felling of trees, but to little avail, since poverty forced people to continue cutting the trees down il-legally, and to continue the practices that were causing the erosion.

In 1979, in an effort to address the sedimentation problem at its root, Plan Sierra was created by the bishop of Santiago and two universities, with support from the Dominican government. The plan uses an integrated approach to solving the problem, which includes credit, training and agricultural extension services, with an emphasis on reforestation and erosion control. The plan includes activities on public lands, projects to supplement income from truck farming and dairy production, in addition to activities related to health, water and environmental health. Since it was established eleven years ago, the plan has been very successful in reversing the deforestation process, improving the standard of living of the hillside populations, ensuring food and energy for them and promoting the establishment of profitable perennial crops such as lumber, fruit trees and coffee.

Source: Lang 1988.

the quantity and quality of the natural resources at their disposal and their particular economic and demographic prospects and circumstances, both groups share many concerns. Nonetheless, the particular characteristics of each must also be taken into account. Global issues, such as the greenhouse effect, climatic changes and the conservation of biodiversity, are the central points of the agenda of the North. The main concerns of the South, on the other hand, are to restore growth and attain food security. Both these agendas, however, are related. The fact that we share the planet and are moving towards a global economy means that there are inter-relationships with respect to the utilization of basic resources and shared commitments with respect to actions that must be taken. Consequently, the benefits of resource conservation are global in nature and mechanisms must be found for sharing the costs of these actions within a framework of equity and development.

A framework of consistent policies to promote resource conservation

As we have seen, there is an endless array of inconsistencies in economic policy as concerns the objectives of resource conservation and the impact of policy decisions. These are usually the result of a long series of decisions made in response to very specific problems and to the narrow concerns of interest groups, in which the criteria of equity and resource conservation have rarely been used to check the consistency of development policies and actions, even where there has been a direct relationship between the situation at hand and the use of natural resources.

Eliminating these inconsistencies at all levels will be a top priority when adopting a strategy for sustainable development. This should apply to everything from comprehensive development policies to specific instruments on subsidies and taxation, as well as the different regulatory schemes necessary, since it will be difficult to overcome existing problems without some kind of State intervention. At the global level, the import-substitution policies and subsidy schemes adopted by most of the countries in 1950 to promote industrial growth have been highly discriminatory towards agriculture in general, and traditional products in particular. The low prices for agricultural products resulting from these policies discourage conservation practices and have in many cases made intensive overutilization of resources the most profitable option. Moreover, they have reduced, if not eliminated, incentives to invest in infrastructure and to make improvements at the local and farm levels. This, in turn, has eventually led to a reduction in the productivity of resources.

The impact of low prices has been compounded by a lack of other types of incentives to foster resource conservation. The absence of policies that treat ecological regions differently in order to promote appropriate production patterns, rather than overall production objectives, and the targeted usage of instruments such as credit, has prevented greater dissemination of production strategies based on judicious management of resources.

On another level, there can be no doubt that policies providing subsidies for fertilizers and other agrochemicals have contributed significantly to increasing environmental pollution and resource degradation; the cases of tomato production in the Dominican Republic and cotton production in Nicaragua and other countries are extreme examples, but many other situations can also be mentioned. Another example of how subsidy policies have had a negative impact on the sustainability of production is related to the price of water. Artificially low prices for irrigation waters have often led to soil depletion and to a shortened life of infrastructure because operators are unable to afford maintenance costs.

It will be of key importance to modify the criteria used in the definition and use of these instruments, in view of the role they play in correcting market signals as regards resource management. The problems of resource conservation and sustainability stem from the fact that many ecological services are considered public goods, and from the discrepancies between social and private costs and benefits (a good example of this is the "service" provided by certain ecosystems in conservation and water distribution which have no market value). In market economies, subsidies and taxes are powerful instruments for correcting these discrepancies and encouraging or discouraging certain activities.

TROPICAL FORESTS AND THE WORLD'S CLIMATE

The role of tropical forests in regulating the world's climate is a topic of growing importance to the international community.

The cyclical mechanism for distributing heat begins with the production of water vapor in the tropical forests, primarily by the evaporation of drops of water from the leaves and trunks of trees and by the transpiration of water through the leaves. The water in the soil remains in equilibrium because trees extract water through their roots and transport it to the leaves for transpiration. Water vapor rises, cools and falls to earth again. In the case of the Amazon basin, this cycle provides 50% of total precipitation; the other 50% comes from moist air blown in from outside the basin, especially on winds that cross the Atlantic Ocean. As the water vapor rises and condenses, it releases latent heat into the surrounding air some 10 kilometers above the earth, which is carried toward the poles and then descends to replace the air that has been drawn to the Amazon to replace the rising humid air.

It is estimated that large-scale deforestation can reduce precipitation by as much as 20%. The less precipitation there is, the less evaporation/transpiration and release of heat in the upper atmosphere take place.

All of the studies on the role of the Amazon in the environment indicate that the Amazon jungle does not produce most of the oxygen breathed around the planet. It does, however, act as a heat pump, preventing global overheating and drastic changes in the climate worldwide. This function is not taken into account in economic calculations and, therefore, is not considered a "product" of the forest. To prevent large-scale destruction of tropical forests, it will be necessary to make institutional adjustments whereby a specific economic value can be given to the role of such forests worldwide, and which make transfers/compensation possible between the strongest economies and the countries of the tropical belt where these forests are located.

Sources: Gallopin 1990; UNEP 1990c; Salati 1990.

In the future, subsidies and taxes must be used to promote sustainable development and resource conservation, not to undermine them as they do at present. In this regard it will be essential to ensure that the price of natural resources (soil, forests, water, etc.) is sufficiently high to promote prudent use, and subsidies for pesticides, fertilizers and other agrochemicals should be avoided. It will also be important that the macroeconomic variables of adjustment, such as exchange rates and interest rates, as well as prices for agricultural products encourage conservation practices and long-term investment.

Current policies to open up trade must be carefully analyzed; if they are not supplemented with schemes that make it possible to "internalize" externalities created by certain activities, there is a serious risk that efforts to improve competitiveness will have a negative

impact on natural resources and the environment. The market is an extremely powerful tool for orienting economic activity and promoting growth, but unless reforms are made to ensure that prices reflect long-term scarcities, there is a risk that growth will be pursued by "mining" resources, rather than by developing true competitiveness. The recent cases of fishery and forestry activities in Chile are a good example of this type of problem (ECLAC 1990a).

Here it is important to examine more closely the international situation with respect to Latin America and the Caribbean and the policies of international agencies for financing development projects, which demand economic liberalization as a prerequisite for technical assistance. Unquestionably, trade liberalization is justifiable in the case of industrial products in the countries of the North where subsidies are minimal, and where protectionist policies have failed in the developing countries. But in the case of agricultural activities such as grain production and livestock raising, the industrialized countries subsidize their farmers; as a result, prices on the world market do not reflect real production costs. This works against the interests of developing countries, which lose markets and have to adopt protectionist policies and seek assistance to convert their production or improve their competitive capacity. This is not to say that indiscriminate use should be made of subsidies, but rather that subsidies should be used in Latin America to promote changes that will make full use of comparative advantages over the long term. The region's advantages in terms of natural resources are enormous, since it has abundant soil and water resources, as well as great biological, cultural and technological diversity. In this context, it may be necessary to establish some type of protection for economies based largely on the agro-forestry sector (both traditional and modern) since its competitors are subsidized; in the case of new products and production strategies, sufficient time must be allowed for new systems to develop.

Another important issue is land tenure policies that limit land ownership. A lack of clearly defined property rights is bound to discourage investment in conservation practices and in the improvement of production capacity; in the final analysis, it will have a negative impact on the sustainability of production (Pomareda 1990). Similarly, many land settlement and rural development policies and programs do not take into account environmental, social and cultural considerations, and this has also had a negative impact on the environment and on ecological and economic sustainability.

An institutional framework that reflects the objectives and needs of sustainable development

We have already called attention to the problems and inconsistencies of policy frameworks that will need to be changed to achieve sustainable develop-ment. Every policy is conceived, designed and implemented within the context of certain institutions and institutional systems. To change the orientation of policy and promote specific kinds of behavior, consistent with sustainable development and the conservation of natural resources, the institutional systems will also have to be modified. Unless the very logic with which policy decisions are made is changed, it will be difficult to achieve the desired impact on the way society uses its resources to attain development objectives.

Institutional reform should be seen within the context of the political and economic adjustments currently under way in the region. In most of the countries, the move toward greater political democratization in the 1980s is laying the necessary foundations for change. Institutions that permit greater participation in the decisions affecting natural resources cannot be developed without democracy.

Civil society plays a major role in democratization. Sustainable development must be conceived as the overall responsibility of society; hence, it must involve all social sectors and forces. Therefore, new schemes of social organization must be established at the local and regional levels, and ways must be found to develop links between the public and private sectors, to ensure greater and more direct participation in decision making as regards the environment and natural resources. This will make it possible to mobilize more funds on behalf of sustainability, exert pressure on the State to adopt more appropriate policies, make the necessary sacrifices more acceptable within the context of a new social contract, and make the general body of knowledge available to new initiatives. Nongovernmental organizations (NGOs), universities and private companies can all play an important role in these efforts.

To achieve this, requires political, administrative and economic decentralization. This will draw the State and society closer together and facilitate the necessary participation of individual communities in the decisions affecting them; it will also improve the efficiency of service provision, both because a smaller scale of operations will not require such sophisticated management skills —a resource which unfortunately is all too scarce— and because it will become possible to better adjust these services to the characteristics and needs of each location.

Cuadro 1. Appropriate policies for sustainability.

Type of Policy	General Purpose	Policy Instrument	Expected Impact
1. Macroeconomic	To adjust relative prices	a. Devaluation	I. More profitable to invest in agriculture II. Less profitable to use imported capital (agrochemicals, etc.)
		b. Low interest rates	I. More profitable to invest in long-term activities
		c. Tariff policies that do not discriminate against agriculture or promote the import of inputs	I. More profitable to invest in agriculture II. Less profitable to use imported capital
	To finance state activity	a. Taxes	I. Resources ensured for implementing policies on sustainability
2. Sectoral	To adjust relative prices	a. Eliminate controls on food prices	I. More profitable to invest in agriculture
		b. Subsidized credit for sustainable practices	I. Greater investment in soil conservation, prennial crops, etc.
		c. High fees for irrigation water	I. More efficient use of water
		d. Eliminate subsidies for for deforestation and agrochemicals	I. Less deforestation
		e. Limited road construction in settlement areas	II. Judicious use of agrochemicals

Table 1 (continuation).

Type of Policy	General Purpose	Policy Instrument	Expected Impact
		f. Direct subsidies for reforestation and management of natural forests	I. Less deforestation in settlement areas
3. Legal	To reorient the use of resources	a. Land titling and guarantee of ownership	I. Greater investment in long-term activities
		b. Creation of protected areas and participation of local population in their management	I. Soil conservation
		c. Laws on genetic heritage	I. Greater investment in conserving genetic diversity
		d. Laws on pesticide use	I. Judicious use of pesticides
		e. Land use planning	I. Soil conservation
4. Anti-poverty	To improve access to opportunities	a. Education	I. Population more aware of environmental problems
			II. Participation of population in resource management
		b. Job development	I. Less pressure to carry out activities harmful to the environment

The serious deterioration of public institutions over the last few years, as well as the growing popularity of the idea that the State must be reduced if administrative modernization is to be achieved, can have a negative effect unless there is a clear awareness of exactly what role the State should play in promoting sustainable development. There is broad consensus that agroecological zoning and land-use planning are essential components of any strategy for

THE FORESTRY SECTOR IN CHILE: A SUSTAINABLE STRATEGY?

The recent surge in forestry activities has been made possible by laws and incentives adopted within the framework of an export promotion policy. Investments by the State in rebates for forestry activity, which cover up to 90% of the expenses; the removal of restrictions on the export of timber and of tariffs on imported capital goods; the opportunities offered for repatriating foreign exchange revenues; legislation with blatant loopholes in the regulations concerning the management of native forests (allowing their substitution with exotic species and clear felling, and not requiring reforestation with native species) led to a spectacular growth in forestry exports (US$850 million in 1990 compared to US$42 million in 1974), and in investment (US$3 billion committed for the 1990-1993 period), as well as in reforestation with exotic species, which jumped from 400,000 ha in 1974 to 1,300,000 ha in 1990. Eighty percent of reforested areas were planted with Monterrey pine and the other 20% with species of eucalyptus.

For investors, one of the main attractions of investing in forestry activities in Chile was the possibility of exploiting large forests of native species and replacing them with plantations of fast-growing exotic species. This provided an immediate return and high profitability of investments.

The diversified mixed native forest of Chile is a closed and balanced ecological system that produces humus and facilitates biochemical activity, maintaining the forest in a healthy state. Replacing it with exotic plantations has had a considerable impact on the environment. It has reduced water and nutrient availability because of the pine's inability to produce the organic residues needed for humidification. It has affected soil structure as well as its physical-chemical properties, altered the stability of watersheds and drastically affected the flora of the forest floor and wildlife. Given the above, it is not surprising that the long-term viability of the initial strategy is being questioned, as evidenced by the analysis currently under way of forestry legislation in Chile, which is aimed at restoring the importance given to native species.

Sources: Lara *et al.* 1990; Cruz and Rivera 1983.

sustainable development (IDB and UNDP 1990). The question is, however: Can these efforts be successful without a strong State? The aim should not be to eliminate State participation altogether, inasmuch as it is often indispensable, but rather to find new ways to make it more effective (ECLAC 1990a). In many cases, this will mean that the State must be stronger and

more effective than it is at present, and that it must be able to design and implement multidimensional policies. The modernization of the State or public apparatus which is being promoted by economic adjustment programs represents a unique opportunity to move in the right direction; nonetheless, it will only be possible if decisions are based on an analysis of the necessary role of public institutions in delivering their respective goods and services within a strategy that promotes modernization with equity and resource conservation, and does not only consider the fiscal objective of balancing the macroeconomic accounts.

At present, one of the public sector's main problems at the institutional level is the sharp contrast between the interdependent nature of the different aspects of sustainability and the highly fragmented mandates of the institutions currently dealing with the challenge of sustainable development (Dovers 1989). In most cases, the inherent relation between the environment and natural resources and economic decision making is not reflected in existing institutional systems: only in exceptional cases are macroeconomic, trade and even sectoral policies designed with due regard for their potential impact on the environment and on natural resources.

Operational ties between different agricultural services —research, extension, credit, marketing— are either nonexistent or weak, even when such services are provided by the same department or ministry. The prevailing trend is to deal with individual products or crops in a vertical fashion, with priorities and policies being designed as if the conditions of production were the same from the ecological, economic and social points of view (Girt 1990).

Although our trying experience with integrated rural development projects has shown that it will be difficult to efficiently integrate the different policy dimensions of sustainability, it is essential to at least establish mechanisms for ensuring that overall and sectoral economic policy decisions are made with full knowledge of their impact on the environment and on natural resources, and of the corresponding social costs and benefits. In the final analysis these policies will determine how natural resources are used and whether agriculture can be developed in a sustainable manner (Dovers 1989; Pearce 1989; Williams 1989).

Any action strategy for sustainable development must include the reorientation and reorganization of the institutions responsible for certain services such as credit, research, extension, education and health.

The high interest rates paid by small farmers for credit could be reduced through institutional arrangements that make access to credit more "democratic" and lower the institutions' transaction and information costs. This would make it possible to plan further into the future, give greater weight to sustainability problems in farm-level decision making and thus contribute to ensuring that the resource use will be more in keeping with what is best for society (ECLAC 1990 a,b).

Furthermore, agricultural research should be organized in such a way as to ensure adequate coordination between efforts dealing with agriculture, livestock, forestry and natural resources in general. In addition, closer and more flexible ties should be forged between public institutions, the private sector, universities, NGOs and other institutions, in order to mobilize more resources and improve the effectiveness of the agricultural technology innovation system.

An important point to consider when discussing institutional reform in this field, and particularly as concerns the role of the public sector, is that the benefits of sustainable technologies are more of a social than a private nature —although they may be profitable at the farm level. Therefore the private sector is not likely to show much interest in developing them. This does not mean that the public sector will have to assume full responsibility for creating such technologies, but it does imply that the public sector will have to ensure that such technologies are developed and made available to producers.

Over the last 20 years, technology transfer systems have evolved into what can be best described as technical assistance systems, generally of a private nature, for transferring know–how in the form of inputs or practices directly associated with the use of inputs, mainly to individual producers. Indeed, the more traditional concept of agricultural extension, aimed at upgrading producers' farm and crop management skills and developing the social and production aspects of community life in general, has clearly decreased in importance, and in some cases even disappeared.

This is a major problem that must be solved if efforts to promote sustainable agriculture are to be successful. Moving toward sustainable agriculture will require greater emphasis on technologies that help improve resource management and farm management as a whole (agronomic practices, crop-rotation systems, farm management models, agroforestry, forestry systems). In addition, it will be necessary to work with groups of farmers rather than individual farmers to ensure that certain types of technology (integrated pest management, watershed management) are adopted by all the farmers in a given area or watershed, who must adopt the change at the same time if it is to be effective. These types of technologies require public transfer mechanisms such as education, training and work with groups, rather than the now more common technical assistance models based on work with individuals. To develop this type of mechanism, public sector agricultural extension systems must be given greater priority; this will not be an easy task, considering the current emphasis on reducing the role of the public sector in this type of activity (Trigo 1990).

Finally, institutional innovations are required so that accurate appraisals and inventories of natural resources can be made, which would serve as a basis for ensuring that individuals make decisions consistent with sustainable development. Such innovations would make it possible to improve the functioning of certain markets, such as the land market, which often do not reflect the true relative scarcities of these resources. Another aim would be to create markets for specific ecological goods or services that are largely considered free goods. It is also becoming ever more necessary to invest in cadastral services with a view to streamlining the land titling and transfer process, or to create transferable certificates of ownership. Some countries have already accumulated a certain amount of experience with these types of measures.

In other areas, however, such as biodiversity and germ plasm resource management in general, the nature of the innovations required is far more complex, especially if we bear in mind that scientific progress —biotechnology— is rapidly changing the economic role played by genetic resources. In the future, genetic resources will become increasingly important to sustainable agricultural development, as will the possibility of privatizing the use of these resources, most of which are still available with practically no restrictions. Greater importance

is being given to discussions on laws and other forms of protection for plant varieties, and on the patenting of germ plasm in general. Clear, workable definitions on this topic will be a key aspect of the institutional framework for a strategy of modernization with equity and resource conservation.

Indicators that provide relevant information for decision making

A new outlook that reassesses the future and recognizes resource conservation and more sustainable production patterns as essential elements of the development model will require an information base that provides a better understanding of basic interrelationships within the biophysical systems, and between these and the socioeconomic and political systems. Such an information base must also provide accurate data on specific aspects of the natural resource and environmental situation at any given moment.

It is inevitable that a certain proportion of the natural resource base will be destroyed during the course of the production process. The key point here is that the decision about what should be preserved and what can be destroyed must be made with full awareness of the future production options that will be eliminated and, consequently, of the nature and magnitude of the intergenerational transfers that are being made (Pearce 1989).

Thus, the aim of sustainable development is to prevent the destruction of resources and to change the way in which they are used, so that renewable resources may be regenerated by the ecosystems, either naturally or with human intervention.

To convince decision makers that it will not always be possible to replace ecological capital or its services with man-made "capital" requires more than merely drawing up of a list of cases where it is impossible or where it can be only be imperfectly achieved. An understanding is required of the basic characteristics of the environment and of the dynamics whereby water, soils, climate and genetic resources interact with each other and within the different production systems used by human societies. A greater and deeper understanding of the phenomena —and the dangers— involved will eventually bring about the necessary changes in attitudes (ECLAC 1990a).

For a variety of reasons, much more information is available on temperate than on tropical zones. Since the consequences of environmental problems in the tropics have a greater impact on the global environment, high priority must be given to developing indicators and gathering information on these regions.

At the same time, agreement must be reached on which indicators to use when analyzing the environment and natural resources. The indicators currently in use are incomplete and may often give rise to misinterpretations and erroneous policies (ECLAC 1990a). A good example is provided by indicators used to gauge the productivity of crops or the degree of agricultural pollution. Current indicators of productivity measure yield without taking into account the impact of production on the stock of resources. A more appropriate indicator would measure both input/output ratios and changes in the availability of resources (mainly land and water). This would be much more useful for decision making; for example, in making a choice between

various technological options (Swaminathan 1989). As regards pollution, most indicators measure the level of use of chemical inputs and their effect on products, soils, water and air. They usually do not take into account contamination resulting from biological processes, such as swine production and coffee growing. Likewise, other indicators, such as those relative to the management of forestry reserves (forestation-deforesta-tion), are too raw, and do not provide specific information (type of forest, species, etc.). Consequently, the information is not very useful for follow-up and decision-making purposes.

Directly related to the issue of indicators is the question of the social accounting systems currently in use. In general, these are incomplete, and do not incorporate variables relating to the environment and natural resources. Hence, the impact of different production activities on environmental resources is not correctly reflected in social accounts. These systems do not adequately taken into account depreciation and they consider the social costs of redressing environmental damage to be economic growth when calculating GDP. This distorts investment decisions and, even worse, favors those with the most negative impact on the environment and natural resources (Pomareda 1990).

The need for a new pattern of technology

Independently of what advances might be made in changing values, institutions and policies, modernization with equity and resource conservation will not be possible unless a new technological path with a more benign impact on the environment and on natural resources is developed.

Modern technology has made it possible to greatly increase the margins of security between production and subsistence. Traditional systems viewed resource conservation as a basic requisite for maintaining production levels (Gallopin 1989). Modern technology has relegated resource management technologies as a production strategy to a position of only relative importance. The most sophisticated example of this is the concept of the "Green Revolution," which provided for the intensive use of energy (agrochemicals, fertilizers, machinery). This approach is now at a crisis point, both because of growing concern over the high ecological cost of the intensive use of energy inputs and because the high prices of fuels and other petroleum products often make it economically unfeasible. In this context, the nature of the technological challenge in agriculture is clear.

Table 2. The estimated cost of sustainable development in Latin America, (1980-2030).

Use of Lands	Area Affected ($X10^6$ ha)	Level of Action	Cost US$/ha	Reference	Annual Investment Average (US$ $X10^6$)*
Natural>Agricultural (Rain-fed)	45	Reconversion (100%)	300 to 500	Hecht *et al.* 1988; Fearnside 1983; OAS 1987	360
Natural>Agricultural (Irrigated)	8	Reconversion (75%)	6000 to 7650	OAS 1987; Masson 1987;	819
		Rehabilitation (25%)	1500 to 3000	OAS 1987; ECLAC 1988, 1989	90
Agricultural> Agricultural (Hillside)	20	Conservation (100%)	350 to 550	OAS 1987; ECLAC 1989 Reiche 1989;	180
Natural>Other uses (Agroforestry, forestry)	33	Reconversion (100%)	200 to 400	Browder 1989; OAS 1987 Reiche 1989	198
Livestock>Other uses (Agroforestry, agriculture)	18	Restoration (100%)	500 to 750	Hecht 1982; OAS 1987	225
Altered>Agricultural (Rain-fed and irrigated)	39	Rehabilitation (80%)	250 to 750	Masson 1987; ECLAC 1988, 1989;	310
		Restoration	750 to 1000	OAS 1987	140
Altered> Altered (Agroforestry, gathering)	75	Reconversion (67%)	15 to 25	Allegretti 1989; McNeely *et al.* 1990;	20
		Rehabilitation (33%)	250 to 450	Reiche 1989	175

Table 2 (continuation).

Use of Lands	Area Affected ($X10^6$ ha)	Level of Action	Cost US$/ha	Reference	Annual Investment Average (US$ $X10^6$)*
Other uses>Forestry plantations	71	Reforestation (100%)	200 to 400	McGaughey *et al.* 1983; FAO 1985; Sedjo 1989; Salcedo 1987	426
Uncultivated land>-Other uses	2	Rehabilitation (50%) Restoration (50%)	1500 to 2000	Jordan *et al.* 1988	70
Other uses>Natural	50	Restoration (50%) Rehabilitation (50%)	160 to 250	Janzen 1988; Cohn 1988	205
Natural>Natural	185	Conservation (100%)	10 to 15	McNeely *et al.* 1990	46
Conservation and management of watersheds	25.5	Conservation (75%) Reforestation (25%)	300	ECLAC 1988	153
Total	571.5				3 413

* Does not include investments in industrial development and infrastructure (roads, dams, etc.), nor scientific and technological development.

Source: Gallopin and Winograd 1990

Neither production nor productivity can be the variables which have to adjust; in view of growing population pressure, and the increased demands on agriculture to reactivate the region's economies, long-term objectives cannot include major production cutbacks and must combine resource and environmental conservation with higher levels of economic activity and growth. This can only be achieved by means of a far-reaching transformation of technology (Trigo 1990).

To meet this challenge, new research must be undertaken. While there is now a large stock of appropriate technologies from the economic, social and ecological standpoint for a significant number of the region's ecosystems, all too often research and extension activities have focused on specific products and species, overlooking the interrelations that exist between them and the other elements of the ecosystem, which have considerable impact on farmers' behavior and decisions to adopt new procedures (Gallopin 1989). Thus, a first, critically important step will be to revise the processes and methods used for identifying research priorities and allocating resources, with a view to including the objectives of natural resource conservation and the promotion of sustainable agricultural development.

Within this framework, and without presuming to make an exhaustive analysis, we would suggest the following as some areas of immediate importance. The first area is general in nature and, to a certain extent, must be seen as the framework for all research efforts. It involves upgrading knowledge on the nature and behavior of the different ecosystems, as well as the indicators and data bases. This will improve the capacity to analyze the potential impact of different options and to follow up on their development once they have been applied. Here, advances in the fields of microelectronics and information sciences (simulation models, remote sensing, expert systems, data base management, etc.) open up a broad range of opportunities for developing more realistic and efficient management plans.

The second area has to do with the utilization of the region's genetic resources. We have already stressed the importance of the biological diversity of the region and the fact that only a minimal amount is being used. A new strategy of sustainable agricultural production must incorporate genetic resources. First of all, it will be necessary to complete the inventories and evaluations of the resources currently available in the region; secondly, a re-evaluation should be made of the potential use of local resources which are well-adapted to the region and can be efficiently used in sustainable production programs, i.e. as substitutes for crops introduced from outside the region, many of which are extremely dependent on the use of agrochemicals. Making food accessible to the entire population is one of the most important components of any sustainable development strategy, and the region has a large enough genetic base that this should not pose any major problems. At present, however, most of the food produced and consumed in the region comes from introduced species; most research and technology development has targeted temperate climate species, and not enough effort has been made to take advantage of native species. An additional reason for giving priority to new policies and efforts related to genetic resources is the importance of such resources in light of the new biotechnologies.

A third area of priority deals with management technologies for farming systems, crops and resources. Most work to date has concentrated on specific crops and on the use of inputs. New technologies must place greater emphasis on integration —between crops, pastures, forestry, animals— and on optimizing resource use rather than seeking to establish productivity ceilings

CULTURAL HERITAGE, LAND USE AND AGRICULTURE

Native indigenous populations and campesinos of Latin America have been able to adapt not only to the environment, but also to 500 years of abuse, loss of cultural heritage and isolation. In some places, the agricultural practices of these peoples involve migratory farming, a technique that makes it possible to give sustained use to ecosystems that are fragile and not very fertile when used for intensive agricultural activities. Likewise, traditional campesino agriculture has often proven to be highly sustainable, using sophisticated management techniques adapted to local conditions (hillside lands, flood-prone areas). These two types of agriculture make use of local genetic resources and species diversity; involve productive continuity and optimal use of space and local resources; recycle nutrients, waste, water and energy; conserve water and soils; breed locally suited species and protect crops through pest control. This sustained use of so-called fragile areas, including tropical forests, hillsides and the Puna region, often contrasts with the failure of introduced modern technologies. Successful land use involves not only a certain level of technology, but also social organization, an understanding of the environment and its resources, appropriate consumption patterns and a positive approach to the environment. Such experience tells a story and is a valuable resource for development.

These technologies, which in many cases are extensive in nature, can be improved, as shown by the new agroforestry and gathering systems. Furthermore, these groups have demonstrated great capacity for assimilating introduced crops and techniques they find useful, which enormously increases the potential for technological hybridization. In addition to using land efficiently, traditional agriculture produces competitive yields and provides foodstuffs and other commodities which often have no competition on the international market, which means they can be exported. Also, it requires a minimum of agricultural inputs.

Source: Gallopin *et al.* 1990

for each crop, a typical approach of the Green Revolution. Some areas which will be increasingly important are soil management and conservation, use of organic fertilizers, minimal tilling systems, integrated pest management, farm-forest-pasture systems and recycling of waste products. At an aggregate level, studies of agroecological zoning and watershed and microwatershed management, among other topics, will also require greater attention.

The fourth important area is biotechnology. Advances in this field, particularly as regards the development of new, ecologically more benign relations between human beings and the environment, offer important opportunities. In addition to genetic improvement of species and the development of biocides, we have the opportunity to recover genetic resources and clean up water supplies and soils through biotechnological processes. Since biotechnology is a rapidly developing field, it is imperative that well-defined and aggressive strategies be devised that

INTEGRATED PEST MANAGEMENT FOR RICE (EASTERN PLAINS OF COLOMBIA)

One of the most important technological success stories in Latin American agriculture is the green revolution in rice in Colombia. Through the use of high-yield varieties and fertilizers, it was possible to double rice yields from two to four tons per hectare over a ten-year period. Among the institutions that made this possible was the International Center for Tropical Agriculture (CIAT). It collected and made a preliminary selection of varieties from which it extracted germ plasm, which was then transferred to the national rice program of the Colombian Agricultural Institute (ICA) and the Rice Growers Federation (FEDERROZ) for testing at the national and regional levels and to determine which would be used. The next step was delivery of the basic seed to private enterprises, which multiplied, distributed and publicized the new variety. Rice growers also benefited from private technical assistance from agronomists thoroughly familiar with the new varieties being recommended.

This institutional set-up, however, was not able to promote management practices that favored sustainability. In the 1980s, CIAT conducted a study of rice production costs in the eastern plains of Colombia, and found them to be very high, at least partially because of excessive pesticide use. This led to the implementation of a plan to reduce costs, with heavy emphasis on integrated pest management.

The institutional effort to reduce pesticide use was not as well accepted by the growers, private agronomists or local commercial firms. In contrast to what is required in introducing a new variety, integrated pest management requires more intense training, where growers learn how to calculate critical levels of damage and evaluate various options. The private technical assistance system was not prepared to offer this type of service, and private agronomists knew very little about this approach. In addition, integrated pest management requires collective action by producers, which went against the individual approach of private assistance. When new varieties were made available, seed companies had a vested interest in marketing them. However, reductions in the use of pesticides ran contrary to the interests of local pesticide vendors; hence, their support was less enthusiastic.

involve all the interested parties and all the countries of LAC in making use of this new type of technology.

In order to deal with these priority issues, it will be necessary to strengthen and consolidate the institutions that generate and transfer technology, as regards both human and budgetary resources, which have deteriorated markedly largely as a result of the crisis (Trigo and Runsten 1989).

NATURAL RESOURCE MANAGEMENT AS PART OF NATIONAL ACCOUNTS

Everyone is familiar with the indicator most commonly used to measure the revenues of a country: the Gross Domestic Product (GDP). What many do not know is that this indicator is highly biased because it does not reflect the depreciation of natural resources. The economic concept of income has always included the idea of sustainability, defined as the amount that can be consumed in a given period without having to reduce consumption in the future. Therefore, when revenues are calculated, depreciation is subtracted right away. Obviously, no business can afford to consider the value of its installations, machinery and equipment, used over time, as income. However, when national accounts are drawn up to determine the revenues of a country, "depreciation" of its natural resources are not normally taken into account. The calculation does not include the forests, soils, energy sources, minerals and other resources used during the period, and which will not be available for use in the future.

Recent studies reveal that when the loss of such resources is taken into account, the real income of countries whose economies rely heavily on the extraction of natural resources is far lower less than official calculations would indicate. This distinction is not purely academic; the use of current indicators often motivates governments to "mine" their natural resources, for the purpose of increasing national "income" over the short term, with disastrous results for future generations.

In the case of Costa Rica, when depreciation of its natural resource capital is subtracted from the agricultural GDP, we find that the figure is actually 29% lower, on average, between 1970 and 1988, than that reported in the national accounts.

Once such depreciation has been deducted, the overall GDP is 5.7% less, on average, for the period between 1970 and 1989. This difference is important because economic leaders consider increases of 2% as successful, and similar declines as an indication of the need for new and urgent economic adjustments. The inclusion of considerations on the natural resource situation in national accounts will enable political leaders to make sounder judgements regarding the safety of the country's basic capital. The level at which the difference is set is of great importance. While for the first fifteen years the average decline in the value of the GDP was 5.25%, for the last four years it fell an average of 7.43%, with a maximum of 8.9% in 1989. This proves that the deterioration of natural resources has a direct and growing effect on production.

Sources: Repetto *et al.* 1989; Tropical Science Center, World Resource Institute 1991.

The need for a new human resources profile

To achieve a more sustainable path of development, a major effort will have to be made in the area of human resources. The human resources we have today do not have the know-how or the management skills required for dealing with a problem of this nature.

An ethic must be developed which incorporates a new vision of the relations between man and the environment. But this new ethic cannot be attained simply by modifying the conceptual framework. New approaches are needed to ensure that the new ethic is applied in specific production situations along with new productive and institutional innovations. To accomplish this, far-reaching changes must be made throughout the educational and training process.

The following matters will require special attention. In the first place, the natural resource dimension must be incorporated into all training activities. It must not be added as an isolated element, but rather fully integrated into the entire educational process, from the primary level up. Likewise, in including this topic in school curricula, account must be taken of local circumstances and of the options available in each community for more effective resource management. These changes will require not only changes in curricula and new teaching methods, but also a major effort to train the instructors themselves, who are rarely qualified to teach these subjects. At the same time, adult education, in-service training, extension programs and other non-formal mechanisms must be promoted, so as to gradually involve all sectors of the community.

This issue must also be dealt with at the level of formal higher education, which is needed to create the technological basis for sustainability. New approaches must be developed that existing educational systems do not cover. Management skills will become very important, since the technologies of sustainability tend to depend less on capital resources than on management and organization. New disciplines will be developed, and they must be better integrated with one another than in the past. The various aspects of ecology and biotechnology are new fields for which the region is still seriously underprepared; at the same time, traditional professional training in agriculture, fisheries and forestry is proving to be obsolete and inadequate to deal with the systemic demands of a more sustainable management of natural resources.

The need for a multinational approach

One of the characteristics that distinguishes the natural resource base of the region, at once a limitation and a source of opportunities for any management and conservation strategy, is the fact that it is shared by more than one country.

A brief analysis of the major agroecological zones of the region shows this clearly. In South America, the Amazon, Orinoco and La Plata basins virtually span the continent, with the exception of the Pacific coast. Likewise, the most important ecosystems not included in these basins, such as Patagonia and the Andean highlands, are shared by two or more countries: Chile

BIOTECHNOLOGY: A NEW FRAMEWORK OF OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT

Advances in the understanding of basic biological functions at the molecular and cellular levels, such as of the transmission and expression of genetic information, reproduction, metabolism and the absorption of nutrients, nitrogen fixing, resistance to disease, pathogenicity, and which have been the focus of the biological sciences in recent decades, have given rise to the development of technologies that make it possible to manipulate these functions. Generically, these are known as biotechnologies. They involve an extremely high degree of precision manipulation and can be used to overcome existing natural biological limitations, such as sexual incompatibility between species and the use of cells or microorganisms to mass-produce biological substances. At the same time, these technologies offer a great opportunity for raising production and productivity ceilings without necessarily placing greater "pressure" on natural resources and the environment.

An outstanding example is the use of genetic engineering techniques to introduce insect-resistant qualities into the genome of cultivated plants, thus reducing the need for pesticides in growing these crops. At the present time, field tests are being conducted in several countries on economically important crops that have been treated with a specific toxin for insects, obtained from the *Bacillus thuringiensis* bacteria. In the near future, other plant species will be developed that have the capacity to fix atmospheric nitrogen (thus reducing the need for chemical fertilizers) and to grow successfully under specific extreme conditions, such as high salinity, in highly toxic soils, or insufficient water.

Source: IDB 1988

and Argentina share Patagonia, and the countries of the Andean area share the ecosystems of the highlands.

In Central America, hillside areas are common to all the countries, and the humid Atlantic region extends from Panama to Mexico. While the dry tropic region is not as extensive, it also crosses national boundaries.

The multinational nature of the resource base limits the feasible options for management strategies. This is more evident in the case of the river basins, given the natural interrelations that exist between the different levels. Without the consent of all the countries, it will be very difficult to coordinate effective and lasting management strategies. In any case, ecological relationships do not cease or change at a country's borders, and the actions and policies of one country affect the resources of its neighbors. Desertification and the loss of biodiversity, as a consequence of deforestation, and subsequent changes in rainfall patterns are examples of such interrelations and highlight the need for coordinated action and common approaches to problems.

Regarding the opportunities this situation offers, two stand out. In the political realm, the shared nature of the resources is one more reason and incentive for promoting the political and economic integration under way in the region. The understanding that ways must be found

to make resource use more sustainable, and that this will only be possible if mechanisms are established where joint decisions can be made and joint action undertaken, expands the conceptual base of integration beyond the purely economic and underscores the need to establish new relations to increase competitiveness to take advantage of opportunities in international trade.

From the technical standpoint, the shared nature of resources constitutes grounds for the development of cooperative programs, especially scientific and technological, which will enable the countries to make better use of available human and financial resources. Here, special mention should be made of the genetic resources of the Amazon basin, recognized as being the most diverse in the world; these resources are concentrated along Brazil's border with Bolivia, Peru, Colombia and Venezuela.

This reality is one of the fundamental reasons for developing plans at the regional level that will make judicious use of natural resources and that are backed by legal instruments and protection measures of regional scope.

The move toward more sustainable production systems will require intense technological development. In many cases, this will not be possible given the capacities and resources of the individual countries, especially the relatively smaller countries, where research and technology transfer are weak and carried out on a small scale. However, it is also a serious limitation in the larger countries. To produce technology appropriate for sustainability demands that research be reoriented and that which is new or relatively underdeveloped, such as agroforestry, be given attention. This will be very difficult in light of the budgetary cutbacks national research and technology transfer systems have been forced to make as a result of the crisis. Here, research networks are a highly effective instrument, both within a given country (to take full advantage of the comparative advantages of the different institutions working on a given problem), and between countries (to share the costs of generating new technologies and of developing common approaches to resource management and conservation).

Looking at sustainability as an opportunity

The environmental and natural resource crisis has given rise to a number of opportunities as well as threats. It has sparked a debate on the need for a more sustainable pattern of development, lending new urgency to the search for ways to use natural resources efficiently and judiciously. It has also given rise to new markets for "natural" products whose growing and processing are compatible with environmental conservation. The discussion of the topic and the conclusions this has led to constitute a strong argument for convincing developed countries to support region-wide development to the benefit of all.

In a broader sense, the urgency of the sustainability issue may spark a new political will to meet the challenges of poverty, institutional reform and commitment to future generations, basic problems that have been overlooked due to the financial difficulties and political instability of recent years. If the two premises on which the discussion of this issue is based are accepted —that the problem of sustainability is so serious that agricultural output is threatened throughout the region, and that the problems cannot be solved until the aforementioned challenges are met—

it is clear that this represents a strong incentive for renewing joint efforts in this connection. Even individuals and sectors hitherto unwilling to share their incomes with others less fortunate and resistant to efforts to regulate their activities may be willing to make greater sacrifices to make the planet a better place.

Most technology for sustainable production is more efficient and less wasteful. For example, integrated pest management, in addition to reducing pollution from pesticide use and restoring the balance between pests and their natural enemies, also makes it possible to spend less on pesticides, thus lowering production costs. Effective soil conservation can reduce the need for fertilizers. Pollutants such as coffee pulp and waste from other crops can be used to create useful products of high economic value. More careful use of energy resources can produce financial savings and, at the same time, reduce pollution. Given that billions of dollars are spent every year on machinery, agrochemicals and fuel, a savings of 10 to 20 percent can represent an important amount of money.

The increased interest in protecting the environment and in producing "cleaner" food is opening new markets for the region. Markets in the United States and Europe for more "organic" products, and for fresh produce in general, are growing. In fact, consumers are often willing to pay higher prices for healthier, more "natural" products. These markets include not only environmentalists, which make up a special segment of the market, but also large sectors of the population concerned about their health and influenced by information on pollution, health and the environment disseminated by the mass media.

Furthermore, as a result of changes in patterns of consumption, traditional and staple crops of certain areas have been abandoned due to social prejudice or ignorance of their advantages. Some Andean crops are now being adapted and cultivated in Europe, North America and New Zealand, especially for the "natural" products market, while at the same time agriculture in Peru, Bolivia and Ecuador is switching over to low-yield cereals requiring high levels of inputs. Jerusalem artichokes, oca, tarhui and many other species are higher in nutritional value and higher-yielding than the crops that replaced them. Here, the market and development have worked counter to the established goals.

As new opportunities are sought, new uses of plants and their by-products are being discovered and developed. It is paradoxical that countries outside the region usually benefit most from these opportunities. An example is the sweet grass (*Stevia reabaudina*) of Paraguay, which produces a sweetener 300 times sweeter than cane sugar, but is lower in calories. This crop has been cultivated for the last 10 to 15 years in Japan, and recently was introduced in the United States, China, Mexico and other countries, bringing in profits of US$3000/ha/ year. It is unlikely that the benefits of this resource, probably soon to be patented, will be reaped by the farmers of Paraguay who discovered and conserved it. The answer, of course, does not lie in blind nationalism or rigid control over germ plasm resources; rather the strategic value of hitherto unexploited local germ plasm should be a topic dealt with at the negotiation table. The fact is that while the North has the capacity to exploit these resources, the requisite biodiversity is found in the South. For example, 35% of the food and industrial crops of the world come from Latin America and the Caribbean, and only 5% from North America. Many of those calling for conservation today are motivated by such considerations rather than a concern for

equitable development. These resources can be shared, but all parties should benefit in the process.

There are strong indications that the developed countries are beginning to understand that the issue of environmental protection in Latin America is a worldwide concern. The most outstanding example of this is the importance President Bush has attached to environmental protection and the possibility of swapping foreign debt for environmental projects in his Initiative for the Americas. Natural resources have become one of the prime targets for foreign aid and technical cooperation in the region. It is unlikely that this represents a fleeting interest on the part of the donors, since the natural resource problem is worsening with time. The next logical steps in this progression would be a final and comprehensive solution to the foreign debt problem in the region, external support for strengthening the public and private institutions that will be needed to achieve a more sustainable development pattern, and special attention given to the problem of poverty as part of discussions on policy between developed countries and the countries of the region.

7

FINAL REMARKS: TOWARD A WORKING AGENDA FOR INTERNATIONAL COOPERATION

Inevitably, the search for a more sustainable and equitable style of development will demand profound changes in the organization, orientation and behavior of our societies. Even though we have dealt with the topic in a very general way in this paper, we feel that we have made it clear that the challenges facing us require more than minor adjustments and slight changes in direction. The deterioration of our resource base and the unsustainability of the current situation are logical consequences of the development pattern we have chosen to follow, and the problem of the sustainability of development must be seen in the context of the economic and political crisis affecting Latin America and the Caribbean. Financial disequilibria, political uncertainty and instability and the impoverishment of the population all work against the possibility of developing sustainable economic models.

Solution of these problems, however, will not automatically bring about sustainable development. The experience of developed countries shows that not all paths to development are sustainable or compatible with the conservation of natural resources. Consequently, it is necessary for the countries of LAC, in their search for new paths to development, to make a special effort to include the issues of equity and natural resource conservation along with modernization and economic growth. This should be seen as an endeavor involving and affecting all sectors of society, both in individual countries and throughout the world.

To set out on a path to more sustainable and equitable development, it will be necessary to re-define conceptual frameworks, undertake institutional and policy reform, and to re-orient programs to train human resources and generate and transfer information and technology. In most of these cases, progress can be expected to be slow, and it will not be possible to advance with the same speed and effectiveness on all fronts. The amount of funds available will have a major effect on the possibility of achieving the required changes. It must also be recognized that, in many cases, the information needed for deciding which adjustments and changes in direction should be made is scarce, and that it will be necessary to begin by generating basic know-how. Perhaps even more important is the fact that these changes will affect the very structure of vested interests and acquired rights in each society and, as a consequence, the new balances will not be achieved without considerable conflict among the various players.

The problems faced cannot all be tackled in the same manner. Different ecosystems present distinct problems and opportunities. The amount of information available on each one varies and therefore the technological options that can be proposed and the time that will be required for their development will also vary. Other differences concern the levels and types of resource use, and the strength or very existence of institutions and policies to deal with them.

For example, it will be much easier to change land-use or ownership patterns in recently settled areas than in areas in which settlements date back a long time. All of these point to significant differences in the importance, time requirements and costs of each intervention, which must be taken into account if the actions undertaken are to be realistic in terms of what they can accomplish and efficient with regard to the use of available resources. The most appropriate strategy would seem to be the gradual implementation of short-, medium- and long-term actions to address the most urgent problems. At the same time, successful experiences gained in connection with specific problems can provide feedback for changes of a more structural nature at the conceptual and institutional levels.

It must be understood that some changes will take considerable time to achieve, and, therefore, should be initiated immediately. Once it is generally agreed that changes are required in the style of development, it will be necessary to have the know-how and the ability to apply them to specific situations. Thus, research and training efforts will be of top priority, as will the creation of a new information base that will help bring about the required change in outlook and generate a new human and technological resource base for sustainable development.

Clearly, the basic commitment must be made by each individual country. Concerns over the sustainable use of resources and environmental conservation cannot override national sovereignty in terms of institutional and policy decisions. But to arrive at these decisions, it will be necessary first to develop an awareness of the importance and seriousness of the topics, of the different dimensions of modernization with equity and natural resource conservation, and of the nature of concrete alternatives for action. In other words, it will be necessary, in the short term, to garner the political support needed to bring about the required changes through broad-based discussions and analysis. This is an area in which international cooperation can play an important role by facilitating planning, the exchange of experiences and the development of common approaches to work on regional and subregional issues. International cooperation can also develop fora for discussing problems that arise and for monitoring specific situations and actions. Mechanisms could be established for study and discussion with a view to forging the new view of development that includes modernization with equity and natural resource conservation, and to providing information on the institutional and policy reform needed to bring this about.

The development of specific approaches and alternatives to the problems to be solved, as well as of the corresponding information base, will contribute substantially to the negotiations that will surely take place, given the global nature of the problems.

Furthermore, the basic resources we are concerned about are, in the final analysis, common to the entire community of nations. Therefore, many of the solutions will only be able to be achieved through joint decisions and actions. In the case of the large watersheds, for example, specific and physical action must be taken by the countries that share them. In other situations, the interrelationships are more indirect, but no less important; for example, the opening of markets as a starting point for generating opportunities and eliminating poverty in the least advantaged countries where population pressure on resources is the greatest. This merging of interests and need for joint action opens possibilities for a style of international cooperation that is more directly involved in specific actions.

Several types of initiatives can be undertaken. In the first place, great efforts are required for technology generation and transfer, most of which are beyond the possibilities of individual countries. Nonetheless, there are ample opportunities for exchanging know-how on common problems, and emphasis should be placed on promoting networks and other cooperative efforts to combine national capabilities. Considerable experience has already been accumulated in the region in this matter. This will also serve to make better use of available resources. Research and technological development to foster integrated management of natural resources in shared agroecological zones and watershed such as the Amazon, the plains and foothills of the South American tropics, the humid Atlantic region of Meso America, Andean highlands and the La Plata basin, among others, are other high-priority opportunities for international cooperation. The support international cooperation can provide to the generation and transfer of technology for certain crops among the countries of Latin America and the Caribbean and other developing countries in the world would represent an important contribution, as would the horizontal transfer of technology for tropical crops such as sugar cane, coffee, cocoa and bananas.

Horizontal cooperation for developing indicators and information systems and for harmonizing policies and regulations on animal and plant health, the movement of commodities, intellectual property rights and biosafety —first steps in creating the multinational institutional infrastructure needed to support economic integration— should also be considered priority areas of action. The subregional economic integration movement currently under way provides a valuable overall framework for this type of action.

Another concern is the international technical cooperation agencies and their strategies of action. In many cases, they compete with one another rather than recognize the natural complementarity of their mandates. International technical cooperation agencies deal with a broad spectrum of topics, instruments and levels of action, ranging from policies and institutions to production technologies for specific situations, from a global perspective to one focusing on regions and local communities. Given the multidimensional nature of the issue of sustainable development, concrete mechanisms should be sought for coordinating and integrating the efforts of such institutions.

In many countries, although institutional and policy changes have been recognized as indispensable, they lack the ability to bring about such change. While this has traditionally been an area of action of international cooperation, it is now more important than ever because of the nature and magnitude of the changes to be made, the lack of experience and background on the matter, and the domestic and international context in which the change will have to take place. Structural adjustment programs provide an extremely important opportunity and international cooperation has a strategic role to play in ensuring that institutional reforms made under such programs are consistent with the needs and requirements of sustainable development.

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PROGRAM II: Technology Generation and Transfer

The Technology Generation and Transfer Program was created in response to two basic issues: acknowledgement by the countries and the international technical and financial community of the importance of technology for productive development of the agricultural sector; the widespread belief that the potential of science and technology can fully be tapped only in the presence of institutional infrastructures capable of developing technical responses to the specific conditions of each country, and a framework of policies which will encourage and facilitate the incorporation of new technology into production processes.

In this context, Program II will promote and support actions in the member countries to improve technological policy design, strengthen the organization and management of their technology generation and transfer systems, and facilitate international technology transfer. This should lead the way to better use of available resources and a more effective contribution to solving technological problems in agricultural production, within a framework of equitable distribution of benefits and conservation of natural resources.

According to the 1987-1991 Medium Term Plan, the Technology Generation and Transfer Program will concentrate its activities to tackle these problems through actions in five basic areas:

- Technological policy design.
- Organization and management of national technology generation and transfer systems and institutions.
- Development and/or strengthening of human resource training programs.
- Reciprocal cooperation and international coordination of research and technology transfer.
- Formulation and implementation of investment projects.

Program II pursues its primary objective by confronting several factors which hinder and limit agricultural development and rural well-being in the countries of the region. First, technological policy must be linked to other aspects of agrarian policy. Moreover, it is imperative to strengthen the organization and budgets of technological institutions, consolidate duly trained human resources, and integrate research, teaching and technology transfer. Special focus is placed on a problem faced by small countries, where there is a serious gap between the need for technological development and the amount of resources which can be invested therein.

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