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**TOWARD A STRATEGY FOR  
SUSTAINABLE AGRICULTURAL  
DEVELOPMENT**

Eduardo J. Trigo

March, 1991

**PROGRAM II:  
TECHNOLOGY GENERATION AND TRANSFER**



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# TOWARD A STRATEGY FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT <sup>1/</sup>

Eduardo J. Trigo <sup>2/</sup>, <sup>3/</sup>

## I. 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 mankind. 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 and the vastness of the areas at risk, as well as our better understanding of environmental interrelationships and ecosystems, the issue of natural resource conservation has taken on a different kind of urgency.

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<sup>1/</sup> These remarks represent the product of a review of several documents on the issue of sustainable development, environmental and natural resource management and conservation; the documents reviewed are listed in the bibliography. We do not presume to add new data in the discussion of these matters, although we have tried to synthesize the issues that involve agriculture, as a basis for further discussion of strategies, policies and actions that may be required in order to promote modernization with equity and to further the cause of environmental conservation in the new political and economic context of the Latin American and Caribbean countries.

<sup>2/</sup> Director of the Technology Generation and Transfer Program, IICA.

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At present, most of the planet is populated, and in many regions demographic pressure has exceeded the limits of sustainability; in spite of this, 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 almost a billion people are already living in extreme poverty, the level of production achieved by mankind over 12,000 years of evolution must be doubled in the next 40 years. Moreover, we are already witness to many cases of environmental deterioration and we have seen the consequences of utilizing resources beyond their normal limits, thus altering the natural ecological balance. The case of the Sahel in Africa, the destruction of forests by acid rain and the desertification of many large areas of the world, as well as the drop in productivity caused by poor soil management and the excessive use of agrochemicals, all clearly show how widespread the problem is. Rather than hearing now and then about the consequences of the mismanagement of natural resources, we must now live with them as part of our everyday life.

At the same time, we now have access to better and more detailed information on the nature of these problems, which enables us to anticipate the probable effect of specific actions, and to design alternative courses of action that can stop, and even reverse, the processes of deterioration.

As a result of all these developments, the issue of sustainability and proper resource management has become increasingly important and urgent, becoming one of the main items on the national and international political agenda.



In this paper, we offer some thoughts on the various dimensions of the move towards sustainable agriculture, and stress the Latin American and Caribbean viewpoint. The perspective of the developing countries is not opposed to the viewpoints of other regions of the world, but does emphasize the development requirements of this particular region. In the second section, we briefly discuss the concept of sustainability now current. In the third section, we summarize certain data pertaining to the situation of Latin America and the Caribbean, and in the fourth, we discuss the dimensions of a perspective that is specific to the region. The fifth section deals with the possibilities and limitations of a strategy for sustainable agricultural development. In the sixth and last section, we offer some ideas as to specific actions that might be taken, especially concerning research and technological development.

## **II. 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, objective definition for developing clear working guidelines is one of the first difficulties that must be overcome in the effort to define a strategy of action for sustainable development. Indeed, the concept of sustainability implies a certain approach or perspective -a general outlook on the basic relationships of social organization- 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 human society (Girt 1990).

Many attempts have been made to arrive at a working definition (see insert); essentially, however, all the definitions proposed concern the evolution of the relationship between the availability of natural resources and the increasing use -or misuse- of such resources and, consequently, the need for greater consideration to be given to natural-resource management as part of those decision-making processes which affect economic growth and development (See window). In this regard, the most useful definition, for purposes of discussing and developing action strategies to make development sustainable, has been provided by the Brundtland Commission, which formulated the necessity to ensure the satisfaction of the needs of present and future generations keeping in mind 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 for meeting both the requirements and the aspirations of mankind.

**SUSTAINABLE DEVELOPMENT**

...is the management and conservation of the natural resource base and the orientation of technical and institutional change in such a way as 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 existing resource base so as to prevent environmental degradation, in order to satisfy the changing needs of society.

GCIAR

...refers to the use of biophysical and economic resources to obtain products whose current socioeconomic 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

...humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

World Commission on  
Environment and Development, Our Common Future

...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.

### **III. THE DIMENSIONS OF THE PROBLEM IN THE REGION**

In general terms, the outlook for Latin American and Caribbean (LAC) availability of resources 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 cultivated land, 17 percent of all rangelands, 23 percent of all forests, 46 percent of all tropical forests and 31 percent of all runoff water with a potential for stable utilization. It is also one of the most genetically diverse regions in the world, the origin of about 35 percent of the major food and industrial crops, only a very small share of which is currently used (particularly in the tropical areas, where it is estimated that in one hectare of forest in the Amazon, for example, there are more plant species than in the entire territory of Europe). LAC also has around 3 percent of the world's oil reserves and 19 percent of its hydroelectric energy potential (Gallopín 1989).

These aggregate figures, however, do not show the enormous differences that exist among different countries. Far from encouraging, these differences show how important it is 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 area and population 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, in general, the availability of arable land is not a limiting factor, in some areas, including Mexico, Central America and the Caribbean, a very high percentage of 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<sup>2</sup> per year were deforested, i.e., an area equivalent to the total area of Costa Rica or the Dominican Republic.

We have been seen around 2 million km<sup>2</sup> 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, of which 78 percent are 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 (Gallopín 1990; UNEP 1990).

Independently of what these processes may mean in terms of poor use or misuse of a highly productive resource, they do threaten the long-term viability of a large number of watersheds that are strategically important for the food security of some countries. Likewise, they have 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 to mankind.

Although it is very difficult to determine the specific impact of the erosion of genetic diversity, 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 why the preservation of genetic diversity is of such strategic importance to agricultural development and food security.

Similarly, desertification is advancing at an alarming rate, particularly in rainfed ecosystems, where almost 70 percent are already in the process of 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<sup>2</sup> in the region as a whole were affected by moderate to severe erosion processes.

Excessive grazing 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 (Latin American and Caribbean Commission on Development and Environment 1990). In many areas, sedimentation, salinization and alkalinization resulting from the mismanagement of irrigation systems have significantly reduced productivity. Finally, the large-scale and growing use of fertilizers and pesticides is polluting water sources and giving rise to toxic residue problems in crops, which often exceed the maximum levels allowed for human consumption (Gallopín 1989).

This situation is the result of a long series of poorly coordinated agricultural policies and inconsistencies in agricultural institutions, which have opened the way for the ecological deterioration now so prevalent. Import-substitution policies and subsidies to industry -which have been heavily biased against agricultural production in general and traditional products in particular- high population growth rates and the urban "explosion" of the last 15 to 20 years, inequitable land tenancy systems and access

to land, along with settlement and rural development policies and programs designed with no regard for environmental considerations, are some of the components of the unsustainable pattern of development that has prevailed in the region to date. Low commodity prices and land tenancy schemes that give rise to squatting discourage the use of conservation practices and, in fact, have often made "resource-mining agriculture" the most profitable option. This situation is further aggravated by the growing pressure on ever less-productive resources resulting from steady and unplanned population growth, and by the impact of the debt crisis of the 1980s, which led to further overutilization of the ecological capital. The deterioration of the terms of trade and the pressure to export caused by the need to service a growing foreign debt, the rise in interest rates resulting from the restructuring of financial flows to and from the region, and economic adjustments undertaken by the countries are all factors which have fostered a short-term approach and made it more difficult to design and execute far-seeing strategies for sustainable development (Gallopín 1989).

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; the challenge is to find a way to accomplish this without curtailing the growth that is absolutely essential to developing economies in general and to those of Latin America and the Caribbean in particular.

#### **IV. AGRICULTURE, POVERTY, GROWTH AND SUSTAINABILITY**

In moving towards development styles 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 towards such strategies will depend to a large extent on the situation of each economy and on the role played by agriculture within them.

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 in order to pursue conservation-oriented objectives.

Scientific progress, for its part, has provided us with a greater and 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 specific policies and actions to promote conservation and production schemes that take into account impact on the environment and natural resources.



**In this regard, as far as the Latin American and Caribbean countries are concerned, the main contrast is between the social and economic roles of agriculture. 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, it represents the livelihood of a large part of the population; therefore, the options and possibilities are entirely different. Moreover, high population growth rates, combined with inaccessibility to land, 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.**

**This is particularly true in Latin America and the Caribbean. Although some of the differences between this region and other parts of the developing world are due to the wealth and diversity of its natural resources and its tremendous agricultural potential, another**

characteristic of the region is its very large mass of poor peasant farmers who are forced to overuse their land in order to survive. Furthermore, not only widespread rural poverty has an impact on the use and durability of resources: extensive stock-raising, lumber companies and intensive commercial agriculture are also prevalent systems that have a clear negative impact.

This contrast only dramatizes the nature of the challenge that lies ahead. With agriculture occupying most of the human and economic resources of Latin America and the Caribbean, and given the significant comparative advantages it has with regard to 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 debt crisis, 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, or in generating the foreign exchange needed to restore balance in the external accounts. The challenge lies in finding a way to do all this equitably, so as to bring currently neglected peasant farmers into the growth process, preserve and increase the availability and productivity of the region's ecological capital, and ensure the well-being of future generations.

## **V. CONSIDERATIONS FOR A STRATEGY OF AGRICULTURAL MODERNIZATION WITH EQUITY WHILE CONSERVING NATURAL RESOURCES**

The current natural resource situation must not be viewed simply as an undesired effect of the current social structure. On the contrary, environmental deterioration and the degradation of natural resources are, to a large extent, inevitable consequences of the prevailing development model (ECLAC 1990a). 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 policy tools -and sometimes the only ones- for orienting the performance of social groups, essential biophysical and moral issues have been neglected. Thus, the development model in use has been 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 imbalances within the existing structure. Thus, if a new strategy is to be developed for restoring equilibrium between man and the environment, a major effort must be made to modify certain basic patterns of social behavior, and the type of technology used in production activities which provide humanity with the means of survival. In the following section, we discuss some of these issues from the standpoint of the Latin American and Caribbean region and of its 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 geography, population, poverty and food security, as well as the importance of certain ecosystems of the region in the context of global ecology.

**Acknowledging the importance of the future: A point of departure for the new paradigm**

The present structure of social and productive organization - 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 theory at least, production patterns can be defined with relative independence of resource availability, the thought being that in due course human ingenuity can replace any resource that might be destroyed in the course of a given production process (Pearce 1989).

As a result of this viewpoint, as well as of the fact that the market is a relatively inefficient instrument for the allocation of resources over time (indeed, those who make the decisions are today's consumers), and that most of the products or services derived from the ecological capital are "public" goods, a pattern of behavior has been established whereby present consumption is given priority over future needs. This is not seen as "perverse" behavior, but rather as a "natural" response to socially established criteria considered as "normal."

Market economies tend to treat the services provided by ecological capital (flows) as free goods, and as a result the ecological capital tends to be overutilized and eventually depleted. In a world rife with uncertainty and information gaps, this means that, in many cases, no one knows what price (cost) is actually being paid for the decisions that are being taken regarding consumption. Indeed, the future is not considered when valuing different production alternatives; at best, it is discounted at an extremely high interest rate.

There is now an increasing awareness of the issue of sustainability, in that there is a growing realization that current consumption patterns cannot be maintained over time. There is now ample evidence that neither ecological nor man-made capital are infinitely substitutable, that is, 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 has nothing to do with prices. The case of genetic resources perhaps best illustrates this problem (Pearce 1989).

The emphasis on economic growth as the basis of the development model 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 measures of the progress of a society. 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, natural resources like 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 certain minimum level of security about the future, insofar as this is a key factor determining our behavior with regard to scarce goods, 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.

In other words, we must augment the criterion of growth with temporal and social considerations and replace the current growth "ethic" with an ethic that also takes into account the dimensions of equity and conservation. This is absolutely essential if we are to develop a strategy that will foster a style of modernization is equitable and resource-conserving. It will make it possible to develop and support concerned political coalitions, as well as 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).

Operationally, this view should not be interpreted as meaning that the current predominance of the market as the basic instrument for allocating resources must be replaced by another concept whereby

natural resources and the environment would be placed "beyond the price system." Taken to the extreme, the latter would mean that human life could not be expected to go beyond mere subsistence. Quite the contrary, the idea is to make the market work, and in order for this to occur, the price system must accurately reflect the characteristics of ecological capital goods or services and the full extent of their relative scarcity; in addition, there must be a way to make well-informed decisions about how to use the natural resources that are available, assuming that a certain percentage of them will inevitably 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).

In Latin America and the Caribbean, these general concepts take on special meaning, partly because of certain features that are unique to the region, and partly -perhaps more important- because of the economic, political and social context in which the economies of the region have developed over the last quarter century. Political and economic instability have, in great part, prevented the promotion of sustained development.

From an economic standpoint, the crisis in the region has created a series of financial imbalances which have produced sharp short-term fluctuations in relative prices, thus opening the way for arbitrage and making short-term speculative activities more profitable, to the detriment of longer-term production or conservation efforts.

This problem, as well as inconsistent income levels, make it difficult to forecast the economic future. As it becomes harder to predict trends, it becomes more risky to invest in the future and, assuming a degree of reluctance to take risks, there will be a tendency to discount the value of future income at rates that are even higher than the market rates.

As far as interest rates *per se*, the debt crisis has also had the effect of encouraging a trend toward focusing on present rather than on future consumption needs. The globalization of capital markets and the consequent increasing mobility of capital has also been detrimental to resource conservation strategies, as investments in the region have had to compete with alternatives in much more secure environments. The resulting massive capital flight and the overall deterioration of the region's capacity to save favor a short-term approach to the use of resources. Examples of the effects of this increasingly short-term approach abound, but probably the most dramatic picture is that of the poor farmers who realize they are destroying the hillsides they are farming, but who must continue to do so because it is their only hope for survival.

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 groups. This is partly due to the exigencies of democracy in countries where poverty is widespread. Here, politicians are forced to give the people short-term solutions, and the only resources available to them are the natural resources making up the social capital. In other words, where politics are concerned, a very high "discount rate" is applied to the use of resources, and once again, this means that priority is given to present consumption over and above



future needs. In addition, the very weakness of the public sector, aggravated by the fiscal crisis, has undermined its capacity to reflect on and make provisions for future problems. Similarly, the universities, traditionally the "think tanks" of society, have been seriously weakened by the crisis. Public planning agencies have lost their best staff, and planning as such has acquired a bad reputation in the world of politics. All these elements, which unfortunately characterize the Latin American and Caribbean scene, have deepened and dramatized the impact of the short-term rationale that is at the root of the non-sustainability of our development style.

### **The need for a systemic approach and for recognition of 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 of systems (biophysical, political, economic and social) and interdependence are the basic concepts to be used in analyzing the issues and designing possible solutions (Brundtland 1989).

One example of the interaction between the economy and the environment is the thermodynamic cycle through which materials and

energy pass in generating economic goods that have value on the market. Waste (pollution) is produced as a by-product, at no cost to producers, but with a cost to society (Pearce 1989).

At the macro level, economic and policy variables determine the way economic agents manage natural resources. In addition, they exert considerable influence on the possibilities of using certain policies and instruments to implement actions to correct the negative impact of past behavior or to promote new approaches that better reflect the objectives of equity and resource conservation. In economic terms, both the debt crisis and the protectionist practices of developed countries have contributed to establishing parameters that make more carefully planned schemes for the use and conservation of resources not viable in practice.

The overutilization of soils 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. In most cases, these problems are a reflection of price levels (interest rates), 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 purpose, the only viable way to control population growth is to eliminate poverty. By the same token, deforestation and the parallel extinction of animal and plant species will not stop unless a solution is found to the debt problem of the Third-World countries, which pushes interest rates up and leads to the adoption of "resource-mining" strategies as the only viable option over the short term. Thus, the most efficient solution is not to be

found in direct action at the origin 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 interdependence 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 will of the people directly concerned to cooperate and take comprehensive action. Commitment at the local level, however, must be supplemented with action at other levels (policy and institutional) in order to ensure that local efforts and sacrifices bring benefits to society as a whole and are not transferred to other levels or sectors.

Moreover, 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 among countries regarding the quantity and quality of the natural resources at their disposal and their particular economic and demographic prospects and circumstances, they do have many

common concerns. At the same time, the particular characteristics of each country must 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 interrelationships 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 the conservation of resources**

In the final analysis, the challenge of sustainable development must be met by eliminating inconsistencies in policy frameworks. Such inconsistencies are the result of a long series of decisions, usually made to deal with very specific problems and the narrow concerns of interest groups that reflect the objectives of economic growth rather than of resource conservation and intergenerational equity.

The move towards sustainable development does not imply that growth is unimportant as a criterion for development, but rather that it must include a temporal dimension; it is in this regard that existing institutional and policy frameworks are often inappropriate and inconsistent. It is a result of the fragmentation of institutional

mandates and of the fact that 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. There is an endless array of such inconsistencies in the field of economic policy, inasmuch as it is here that the relationship between policy and the behavior of social forces is most direct and transparent.

Unquestionably, 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 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.

As far as producers are concerned, policies to keep the prices of agricultural products low in order to help other sectors have reduced, if not eliminated, incentives to invest in infrastructure and to make improvements at the local and farm levels. This, in turn, has generally led to a reduction in the productivity of resources.

The above remarks do not represent a general stance on subsidy policies. Essentially, the problems of resource conservation and sustainability are a result of discrepancies between social and private costs and benefits, and in market economies, subsidies and

taxes are powerful instruments for correcting these discrepancies and encouraging or discouraging certain activities. The point is to find a way to incorporate these ideas into the policy analysis and design process, in order to bring optimum individual behavior more into line with optimum social behavior.

At the macroeconomic level, international trade policies and those dealing with interest rates also play a major role. It is important to make capital markets more transparent and accessible, especially to small farmers. This would make it possible for farmers to plan further into the future and to prioritize the need for sustainability when making decisions at the farm level. It would contribute to ensuring that the use of resources over time will be more in line with what is best for society (ECLAC 1990 a,b).

Policies aimed at opening up trade must be carefully analyzed; if they are not supplemented with schemes that ensure the "internalization of externalities" of 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 really do reflect long-term concerns, it will be necessary to establish regulatory schemes to compensate for the resulting negative externalities. Care must be taken not to pursue growth by "mining" resources, but rather 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).

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

Every policy is conceived, designed and implemented within the context of certain institutions and institutional systems. In order to change the orientation of a policy framework and promote a specific kind of behavior on the part of social forces, consistent with sustainable development and the conservation of natural resources, the institutional systems will also have to change. Unless the very logic with which policy decisions are made is changed, it will be difficult to achieve the desired impact on how society uses the resources available in attaining its development objectives.

Institutional reform is a central component of sustainable development objectives. As we have already mentioned, the market is not an efficient mechanism for orienting a society's decisions regarding the management of natural resources. Moreover, in sharp contrast to the interdependent nature of the different aspects of the issue of sustainability, there is a high degree of fragmentation of mandates among institutions currently dealing with the challenge of sustainable development (Dovers 1989).

In most cases, the inherent relationship between the environment and the natural resource situation 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. In view of this, what we need are institutional innovations that will make it possible to "internalize the externalities" and, indeed, to create "markets" for resources that are presently considered free goods. Likewise, and even though it

may not seem realistic or practical to consider integrating the different policy dimensions of sustainability within a single organization, it is essential to establish mechanisms to ensure 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 (Dovers 1989; Pearce 1989; Williams 1989).

On another level, it should be noted that issues such as land tenancy and the structure of certain services (credit, research and extension, and plant and animal health), have considerable impact on the conservation of natural resources. Institutional arrangements that limit land ownership are bound to discourage investment in conservation and in the improvement of production capacity; in the last analysis, they will have a negative impact on the sustainability of production (Pomareda 1990).

In most cases, operational ties among services to agriculture 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 vertical fashion, with priorities and policies being designed as if production situations were homogeneous from the ecological, economic and social points of view.

In most of the developing countries, access to credit is very limited for most of the rural population. As a result, the effective interest rate is significantly increased, strenghtening the already existing macro-level, short-term bias, making it even more prominent in production plans and the management of natural resources at the farm level. This situation must be corrected by expanding institutional arrangements with a view to making credit more



"democratic" and promoting sustainability. By the same token, technology transfer systems must be reformed in order to encourage the use of technologies that improve the efficiency of resource management rather than boost productivity by increasing the use of inputs (integrated pest control, for example) (Pomareda 1990).

At the operational level, any action strategy to promote sustainable development will require the creation of mechanisms to stimulate interinstitutional coordination for the management of shared resources (watersheds, etc.) and the reorganization (and reorientation) of the institutions responsible for such services.

Institutional reform, however, cannot be limited to the sphere of economics and purely operational considerations. Sustainable development must be conceived as the overall responsibility of society, and therefore must involve all social sectors and forces. When the State serves as the major, or only, instrument for protecting the environment and conserving natural resources, it has been shown to be ineffective, both in correcting imperfections of market mechanisms and for implementing direct actions. Therefore, new schemes of social organization must be established at the local and regional levels, and ways must be found for developing linkages between the public and private sectors, so as to ensure greater and more direct participation of those making decisions that affect the environment and natural resources. To achieve this, it will be necessary to promote the decentralization of political, administrative and economic processes. On the one hand, this will bring the State and the civil society closer to each other, and facilitate the necessary participation of specific communities in decisions affecting them; on the other hand, it will improve the efficiency of services, either because a smaller scale of operations will not require very

sophisticated management skills -a resource which unfortunately is all too scarce- or because it will make it possible for to better adjust these services to the characteristics and needs of each local situation. This does not mean, of course, that State participation is to be eliminated, inasmuch as it is often indispensable; rather, new ways must be found to make it more effective (ECLAC 1990a).

Institutional reform should be seen within the context of the political and economic adjustment currently under way in most of the countries of the region. In some of these countries, the move toward greater political democratization in the 1980s is laying the necessary foundations for change. Institutions that allow for greater participation in the decisions affecting natural resources cannot be developed in the absence of democracy. However, the serious deterioration of public institutions over the last few years, as well as the growing popularity of the idea that the State must "shrink" in order to achieve administrative modernization, can have a negative effect unless there is a clear awareness of exactly what role the State should play in promoting sustainable development.

As mentioned earlier, many cases of "unsustainable" development have resulted from the fact that the services of ecological capital are often public goods. Another contributing factor is the difference between the private and the social costs of actions affecting natural resources and the environment. In this regard, State intervention is essential; without it, there is no easy way to solve existing problems. Different types of regulatory programs, including resource use planning, subsidies and compensations, or taxes on certain kinds of behavior, are instruments that will have to be used to correct the signals given by market mechanisms and to ensure that, on the private level, those who receive the benefits pay for all costs

involved. In many cases, this will require a stronger and more effective state and government structure, capable of designing and implementing multidimensional policies. The "modernization" of the State and public apparatus as promoted under the economic adjustment programs represents a unique opportunity to move in the right direction, provided that emphasis be placed on the ability of public institutions to deliver their respective goods and services under a strategy that promotes modernization with equity and resource conservation, not only the fiscal objective of balancing macroeconomic accounts.

### **The Need for a New Human Resources Profile**

In order to achieve sustainable development, a major effort will have to be made in connection with human resources. Many of the problems of non-sustainability and resource deterioration stem from a lack of awareness of the role natural resources play in the development of human societies. Moreover, most people do not have the know-how or the management skills required for dealing with the technical and operational problems inherent in efforts to modernize agriculture within a context of equity and resource conservation.

The development of a new ethic is a prerequisite to the establishment of a new human resource base for sustainable development. But it cannot be attained simply by modifying the conceptual framework. Original approaches to social and production issues and new technologies are needed to ensure that the new ethic is applied in specific production situations. To accomplish this, far-reaching changes must be made in the educational and training process.

The following matters will require special attention. In the first place, the dimension of natural resources 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 on 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 on the part of the instructors themselves, who are rarely trained 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.

The issue must also be dealt with at the level of formal higher education, necessary to create the technological basis for sustainability. New disciplines and 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 -organized mostly along strict disciplinary lines- is proving to be obsolete and inadequate to deal with the systemic demands of a more sustainable management of natural resources.

### **Relevant information for decision making**

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

As we have said, the current development model is based, to a large extent, on the concept that ecological capital, or the services pertaining thereto, can always be replaced by man-made capital. This view cannot be reversed merely by drawing up a list of the cases in which this is not possible or where it can be achieved imperfectly. More emphasis must be placed on an understanding of the basic characteristics of the elements making up the environment and of the dynamics whereby water, soils, climate and genetic resources interact with each other and within the different production schemes used by human societies. A deeper understanding of the phenomena -and the dangers- involved will eventually bring about the necessary changes in attitudes. This new area of research must be given priority, as it represents a source of information needed at the operational level for making decisions on the use of natural resources (ECLAC 1990a).

At the same time, agreement must be reached as to which indicators are to be used when analyzing the environment and natural resources. The set of indicators currently in use is incomplete and may often lead to misinterpretations and erroneous policies (ECLAC 1990a). A good example is provided by measures used to gauge the

productivity of crops or 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; as for example, in making a choice between various technology options (Swaminathan 1989).

As regards pollution, most indicators measure the level of use of chemical inputs and their residual effect on products, soils, water and air. They usually do not take into account residues or waste resulting from the biological processes themselves, such as swine production and coffee growing, only two of many such examples. Likewise, other indicators, those pertinent to the management of forestry reserves (forestation-deforestation), 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 question of indicators is the question of the social accounting systems currently in use. In general, these are incomplete, not computing variables relating to the environment and natural resources. Hence, the impact of different production activities on these factors is not correctly reflected in the social account, distorting investment decisions and, even worse, favoring those with the heaviest negative impact on the environment and natural resources.

From another standpoint, more balance is needed in the collection of information. For a variety of reasons, much more information is available on temperate rather than 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.

### **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 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 (Gallopín 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 provides for the intensive use of energy per product unit (agrochemicals, fertilizers, machinery, etc.). 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 of the fact that 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. In Latin America and the Caribbean, neither production nor productivity can be sacrificed to achieve sustainability. In view of growing population pressure, and the increased demands on agriculture to reactivate the

economies in the countries of the region, long-term objectives can not 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 technological transformation (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 these and the other elements of the ecosystem, and which have considerable impact on farmers' behavior and decisions to adopt new procedures (Gallopín 1989).

Thus, a first and 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 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 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 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 actually available in the region; secondly, a re-evaluation should be made of the potential use of well adapted resources native to the region which can be efficiently used in sustainable production programs, i.e., as substitutes for introduced crops, many of which are extremely dependent on the use of agrochemicals. Making food accessible to the entire population is probably 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; this is partly due to the fact that most research and technology development has targeted temperate climate species, and also because 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 in general, for farming systems, crops and other resources. As noted above, most work to date has concentrated on specific crops and on the use of inputs. New technologies must place greater emphasis on

integration -among crops, pastures, forestry, animals- and on optimizing use rather than seeking to establish productivity ceilings for each crop, a typical approach of the Green Revolution. Some of the areas which will be increasingly important are those pertaining to 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 humans 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 to involve all social interests and all the countries in making maximum use of this new type of technology.

In order to deal with these priority issues, it will be necessary to strengthen and consolidate the institutional infrastructure that generates and transfers technology, as regards both human and budgetary resources, both of which have deteriorated markedly largely as a result of the crisis. Furthermore, the very structure of the technology generation and transfer system must be upgraded (Trigo and Runsten 1989). Here, organizational schemes must ensure adequate integration of agricultural research with stock raising, forestry and natural resources in general, as well as promote greater and more flexible ties 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 reforms in this field, and particularly the role of the public sector, is the fact that the benefits of sustainable technologies are more of a social than of a private nature -except as regards profitability 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 should be exclusively responsible for creating such technologies; nevertheless, it does mean that the public sector will have to ensure that such technologies are developed and that they are indeed made available to producers.

Over the last twenty 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 directly associated with the use of inputs, and working mainly with individual producers. Indeed, the more traditional concept of the extension system, 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 sometimes even disappeared. This trend represents a major problem that must be solved if efforts to promote sustainable agriculture based on better management of natural resources are to be successful.

As noted above, moving toward sustainable agriculture will require greater emphasis on technologies that help improve the management of resources and farm activities as a whole (agronomic

technologies, farm management models, integrated pest management). 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, etc.) are adopted, not at the individual level, but rather at the level of the group of producers in a given area or watershed, who must adopt the change at the same time. These types of technologies require transfer mechanisms such as education, training and group work of a public nature, rather than the now more common technical assistance models that target individuals. In order to develop this type of mechanism, the priorities of traditional agricultural extension systems must be revised; 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).

## **VI. FINAL REMARKS: OPPORTUNITIES AND LIMITATIONS**

This issues discussed in this paper emphasize that the search for sustainable development must be viewed as an integrated and integrating effort by all sectors of the national and international society. It will be of no use, for example, to develop new technologies that improve the efficiency of resource use if they are applied in an economic context that promotes resource mining. Similarly, efforts will not be successful if the overall context limits the access of the poor to the resources and opportunities (education, health, etc.) they need to improve their situation as producers and, consequently, their quality of life. Access to resources and opportunities is essential for active participation in economic and social affairs.

In this regard, there must be no further delay in dealing with the already urgent need to promote major investments in the training of human resources. This topic has not received the attention it deserves, and it represents one of the strongest factors contributing to the perpetuation of poverty. Illiteracy must be eradicated and the general educational level of the population must be improved to ensure the viability and durability of actions to maximize the sustainability of development. Unless the most impoverished sectors gain access to services that can truly improve the quality of their lives, they will continue to be forced to seek their survival by overutilizing the more fragile ecosystems which, in most cases, are the only ones to which access is "free."

It is impossible to separate the issue of sustainability of development from the economic and political crisis which Latin America and the Caribbean is experiencing. Financial imbalances,

uncertainty and political instability combined with the impoverishment of the population constitute a general framework which works directly against the possibility of developing economic models that will be sustainable in the future. Unfortunately, solving these problems will not automatically bring about behavior that is compatible with sustainable development. The experiences of some of the developed countries show that not all development models are sustainable nor are they all compatible with the preservation of the natural resource base. Therefore, in their search for new avenues of growth, all the countries of the region must explicitly include the objectives of equity and resource conservation alongside the ones of modernization and economic growth. Only in this way will it be possible to avoid the mistakes of the past.

At the operational level, it will be necessary to promote institutional and policy adjustments, devise appropriate regulatory mechanisms, and reorient technology generation and transfer. Adjustment and modernization programs provide an appropriate framework for beginning such efforts, and it is important to ensure that this opportunity is not wasted. However, as concerns policies and institutions, as well as the enforcement of regulations, major delays can be expected. Resource limitations -including human resources- means that, in many cases, the strategy must be considered a long-term option (this is particularly true in plans that envisage payment of incentives and economic compensation, instruments widely used in the developed world). For this reason, concentrating initial efforts on research and technology transfer appears to be a viable and effective alternative. Investments in this type of activity have high rates of return, which would make it important to combine such investments with institutional adjustments and policies to modify and improve the performance of market mechanisms. The new

opportunities afforded by advances in biotechnology, along with the potential benefits of the interaction of biotechnology with other components of the new technological paradigm (microelectronics, and informatics, for example) support this viewpoint. However, access to these opportunities is not automatic and therefore the countries of the region must give priority, both at the individual and regional level, to developing policies, strategies and programs to ensure that this potential can be fully utilized.

For this to come about, it will first be necessary for the region as a whole to come to terms with the importance and seriousness of these issues. The different dimensions of the issue of modernization with equity and conservation of natural resources must be understood, as must the nature of alternatives for action. Here, international technical cooperation can make an important contribution by facilitating the exchange of experiences and promoting consensus on topics on which the countries can work together at the regional and subregional levels. It can also serve as a forum for ongoing discussion of issues that arise and for monitoring the progress of specific situations and actions.

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