SEEDS FOR THE FUTURE
SUSTAINABLE AGRICULTURE AND NATURAL RESOURCES IN THE AMERICAS
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Interamerican Council for Sustainable Agriculture
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PREFACE

This document is the outcome of group discussions at the meetings of the Inter-American Council for Sustainable Agriculture (ICSA), held in San José, Costa Rica in October, 1994, and in Santiago, Chile in March, 1995. Discussions were based on texts prepared for this purpose by members of ICSA and several guest scholars. The authors, whose work was based on outlines approved in advance, were: Gilberto Gallopin, Lori Ann Thrupp, David Kaimowitz, José Eli da Veiga, Eduardo Trigo, Miguel Altieri, Alicia Bárcena and Víctor M. Toledo. Additional contributions were received from Omar Masera, Aníbal Severino and Emma Romeu. David Kaimowitz and Víctor M. Toledo prepared initial drafts based on the original documents and group discussions. Lourdes Barón and Víctor M. Toledo edited the final versions of the Spanish text and Miguel Altieri reviewed the version in English. The ideas, opinions and concepts expressed in this document are the sole responsibility of the Inter-American Council for Sustainable Agriculture (ICSA).
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NOTE

This document is an initial attempt to outline what could be a vision of sustainable development for agriculture and natural resources in the Americas. It was put together by a heterogeneous group of individuals who share a commitment to sustainable agriculture. They come from different countries of the Americas, work for different types of institutions, and represent a wide variety of academic backgrounds and disciplines. It does not claim to be the last word on the subject, in any sense; instead, it is a document intended to spark thought and discussion by groups and individuals seeking new alternatives to the inappropriate agricultural development patterns prevailing at present.

The material is presented in four sections. The first chapter gives a brief introduction. The second outlines the views of the ICSA on the meaning of sustainable development in agriculture and natural resources. The third chapter takes a look at today's agricultural sector in the region, and the chapter four examines the political, institutional and technological causes of non-sustainability in modern-day agriculture. Finally, chapter five proposes a number of strategies and alternatives designed to sow the seeds for the sustainable future of agriculture in the region.

More in-depth discussion of some of the topics addressed in this essay can be found in the many titles published as part of the series working papers, written by members of the Inter-American Council for Sustainable Agriculture and by guest scholars.
1. INTRODUCTION

Today, as we approach the Third Millennium, there is an urgent need to generate new modes of thinking and to act accordingly to face the challenges of sustainable development.

Prevailing patterns of development have brought serious problems to countries on both sides of the North-South divide. The inherent limitations of these patterns are dramatically evident in two essential dimensions. First, instead of quietly disappearing, poverty has stubbornly continued to rise; second, the environment itself, which is the foundation for development and for a livable world, is being degraded at every level—local, national, regional and global. Development is clearly following an unsustainable course.

Agriculture, livestock production, forestry, mining and fishing are all strategic elements in the quest for a new approach to development. Human society finds its closest link to nature by putting the land into production in the form of agriculture, livestock, forestry and fishing, and no society can develop without these. Human populations lay the foundation of their very survival by producing a variety of foods and raw materials, thus bringing economic growth to their nations. Agriculture continues to be the primary provider of employment in many countries of the Americas, as well as the foremost source of foreign trade. It is the quintessential human use of nature, and, as such, represents much more than a mere productive activity: in fact, most of the region's natural resources are affected by farming, and broad groups of society are directly or indirectly involved with this sector.

Agriculture and forestry have been severely undermined in recent years by a pervasive economic, socio-political and environmental crisis. Hunger and rural poverty persist. An estimated 240 million people are malnourished in the countries of the Americas, and even in the United States, the richest country of the region, hunger is commonplace among the poor. Many rural communities have succumbed to economic and social collapse. Rural employment gives way to new labor-saving technologies, and rural-to-urban flight, along with migration into new areas of the agricultural frontier, are still rampant.

As the population continues to grow, and the amount of arable land shrinks further, food shortages will probably worsen. However, it would be a mistake to suggest that the fundamental cause of the current food crisis is population size per se. In and of itself, the Malthusian hypothesis tends to oversimplify the issues and fails to address the root causes of our problems.

The distribution of resources continues to be profoundly uneven between North and South and even between classes within individual countries. This is one of the fundamental causes of the crisis in agriculture and forestry. Disparities of wealth and income are growing, and inequitable access to the land is on the increase.

"Modern" approaches to agricultural development have resulted in environmental problems such as agrochemical pollution, soil degradation, wasteful depletion of water
resources, and loss of biological and genetic diversity. Although large-scale production has been the chief culprit of deterioration, small producers must share some of the blame for resource degradation. As they are displaced into marginal areas, their struggle for survival forces them to exert undue pressure on the natural resource base.

Inappropriate patterns of rural development are another underlying cause of poverty and the degradation of natural resources. The countries have gone heavily into debt as they entered fully into processes of political and cultural globalization and financial and trade liberalization, all undertaken with very little sensitivity to social and environmental consequences. Moreover, inefficient government agencies have become inordinately powerful and influential, excluding public participation as they push misguided strategies incapable of meeting the needs of rural populations.

The dilemmas are many, and they have led broad groups of farmers, leaders, planners, extensionists and researchers to rethink the prevailing paradigms of agricultural and forest development. Such a change of direction is no mere option, but instead, an imperative that demands no delay. Problems of this nature can never be solved with mere corrective measures, which will inevitably bring more of the same. Instead, the situation calls for substantial economic, social, ecological and cultural change to address the very roots of today's world problems. Full-fledged decentralization is not the answer, nor is debilitation of the nation-state. New alternatives will be needed to strengthen decision-making at the regional and local or community levels, so that control over productive resources can be placed in the hands of rural dwellers and producers. Such changes cannot wait; time is running short, and in the worst cases, it is already too late.
environmental degradation stems from two main sources. The first is associated with prevailing patterns of economic growth in industrialized societies, usually located in the Northern Hemisphere, and with wealthy groups in poor countries. The second derives from the poverty that can be found throughout most of the countries in the Southern Hemisphere. In each of these two situations (unsustainable development and intolerable impoverishment), different processes are affecting quality of life and the ecosphere; but the connections between the two are significant. Closer analysis shows that wealth and poverty are interconnected components of a single model of economic growth, two sides of the same coin: disparate growth that promotes ever-greater inequality and imbalance between rich and poor countries, and within individual countries, between the wealthy and the poor.

Development is not synonymous with economic growth, although common sense would suggest otherwise. Growth is understood essentially as quantitative increase, while development brings qualitative transformation. The purpose of development is to improve the quality of human life; economic growth is merely a means to that end. The concept of “quality of life” involves meeting human needs, both material and nonmaterial, and making hopes and dreams come true. There are many different ways of fulfilling hopes and aspiration, all with different implications for material consumption.

Nor is economic growth necessarily synonymous with material growth. Recent trends favor new processes that tend to dematerialize the economy. For example, the service sector is becoming an increasingly important component of GDP, and newly emerging knowledge-intensive technologies tend to use less energy and material inputs. Nevertheless, “intangible” (nonmaterialized) economic growth, in and of itself, is not the answer for feeding the poor. In fact, the redistribution of material goods and the assurance of intergenerational equity are inescapably pressing issues.

Sustainable development does not mean that economic growth must cease. In reality, the natural consequence of sustainable development is a material economy that has stabilized and coexists with growth in the nonmaterial economy. Sooner or later, material economic growth and demographic growth will stabilize; but cultural, psychological and spiritual growth is bound by no physical limits.

The modes of economic growth prevailing nowadays are facing environmental limitations given the constrained availability of natural resources. They are also limited by the capacity of the ecosystem to decompose and recycle waste and contaminants.

The concept of sustainable development embodies both permanence and change (see Box 1). Sustainability does not mean that everything must be kept constant; in fact
continuity may at times be undesirable. If the focus is on holding the variables of an ecological or social system in a constant state, the system may become inflexible and unable to evolve, despite the fact that change is both necessary and desirable in many systems. The very concept of development conveys the idea of change and improvement.

2.2 Basic principles of sustainable development

New patterns of development in agriculture and forestry need to be ecologically, economically and socially sustainable. No system can be sustainable unless it offers substantial improvements in social equity, among other things. Sustainable development requires equity across generations and within each single generation. Sustainable poverty is unacceptable.

The planet’s resources are bound by clear physical limits, despite expectations emerging from rapid technological progress. This means that the basic level of per-capita material consumption needs to be sustainable. The millions of people presently living in poverty need to consume more, while wealthy minorities will need to reduce material overconsumption, whether by lowering individual levels, improving the material and energy efficiency of the economy, or both.

The world’s population will need to stabilize eventually. This can be achieved by raising standards of living, improving the quality of life and offering better education. Any attempt to stabilize the population by resorting to coercion and violence will inevitably prove ineffective and certainly will not bring about sustainable development.

In the same vein, all members of society who engage in agriculture, livestock production, forestry and fishing need to enjoy equal status, regardless of age, sex or cultural background. Principles of equality must reign between men and women, among people of different ages and races, and among members of different cultures, if sustainable development is to become a reality. There is no question that democracy is the political framework for an egalitarian society. Sustainable development in an authoritarian or autocratic society is not only unthinkable but impossible.

2.3 Central attributes of sustainable agroecosystems

An agroecosystem can be defined as an ecological system modified by human beings to produce food, fiber, raw materials and other agricultural products. It is thus a system that possesses well-defined objectives and means or tools for meeting them.

An agroecosystem is a particular class of socio-ecological system, product of the coevolution between a social (or human) subsystem and an ecological (or bio-physical)
LESSONS OF THE RIO DE JANEIRO SUMMIT

Since the end of the cold war, the international community has been transformed as it seeks a new world order. In the economic realm, the multilateral cooperation system has been fraying, and particularly in the developed countries, a new trend is gathering strength: bilateralism, regionalism and the formation of regional blocks. All of this would seem to contradict the principle of multilateral non-discrimination. Capital, knowledge and technology have all been rapidly privatized during this stage, and the world now has a system of globalized financial markets unconstrained by any international authority for regulating and supervising operations. In such a system, speculative activities now threaten to bring on worldwide financial collapse. The role of the state has been eroded as the IMF has failed to regulate international monetary and macroeconomic policies. The Fund continues to exert heavy influence as an instrument for the investment of external resources subject to structural adjustment policies, and developing countries are increasingly faced with the social and political repercussions.

Governments no longer hold exclusive sway over the course of events; they must now coexist with many other major players, particularly nongovernmental organizations, the media and transnational enterprises.

In this setting of international political and economic upheaval, the United Nations Conference on Environment and Development (UNCED), also known as the Rio de Janeiro Earth Summit, took place from June 3 to 14, 1992. The Summit was the culmination of a negotiating process that had lasted more than two years and had put into practice innovative methods of consensus-building and participation by nongovernmental sectors.

The UNCED offered an unprecedented opportunity to mediate on the global changes described above, and to examine the connections between these trends and prevailing development policies over the past decades. It became a forum where ideologies were seriously questioned and held up to one another. World politics were overhauled, with traditional regional groupings in international negotiating practices actually replaced by regional trade blocs. Agreements were hammered out, and building blocks were set in place for programs oriented toward a new form of international cooperation in questions of development and environment.

Rio de Janeiro drew more than 120 heads of state. Official delegations were in attendance from some 180 countries, along with thousands of nongovernmental representatives, over 8,000 members of the world media, and more than 14,000 nongovernmental organizations from all over the world.

It became very clear at the Earth Summit that the human race had reached a turning point between new opportunities or utter failure. The current economic model has truly produced great material wealth and an unprecedented technical revolution; but it has dangerously favored a small minority. Developed countries have achieved their economic development by impoverishing other nations. This model is unsustainable, opening the door to dangers and imbalances that today threaten the entire human race.

The official outcome of intergovernmental deliberations at UNCED included:

1. The Rio Declaration on the Environment and Development. This political document outlines 27 principles that should govern the behavior of nations to ensure the continued viability and integrity of our planet as a safe, equitable home for the human race.
2. Agenda 21, also known as Program 21. This is the first consensus-based negotiated program of global scale. It subdivides the concept of sustainable development into intersectoral actions and commitments with a multiplier effect.
3. The Biodiversity Convention. This international treaty contains specific provisions for regulating national actions and policies regarding renewable resources, including property rights, value assessment, and marketing.
4. The United Nations Framework Agreement on Climate Change. The objective of this agreement is to bring about a transition in energy use that will protect the atmosphere as a collective good essential for life.
5. Principles for a worldwide consensus on the management, conservation and development of threats of all kinds.
The paradigm shift necessary for sustainable development has not yet come. Quite the contrary, classic economic structures have been strengthened, with an emphasis on free-market policies and structural change.

The trend toward globalization was palpable in Rio. The real problems, however, is that from the beginning, the global agenda was strongly influenced by the Group of Seven, made up of the world's most powerful countries. There was never any truly universal consensus on global priorities, as was evident during the concluding negotiations of the Uruguay Round in Mar del Plata.

The process taught a number of important lessons, including:

1. The relationship between North and South is not a debate; it is a gap. A confrontation between rich and poor is drawing near, and class struggle is more alive than ever before, in the presence of heavy concentrations of wealth in all the countries, north and south alike. The risks to social peace are very high.

2. Over the last four years, conflicts between countries have given way to ethnic and religious clashes. We see the nations moving away from political and ideological confrontation and toward cultural conflict. To make matters worse, the world is now divided into two kinds of countries: those that are included in capital markets, international trade, and the vast geo-economic blocks that have taken shape everywhere, and those that are not.

3. International negotiations and discussions have failed to adopt meaningful processes of democratization. The international economic triad (World Bank, International Monetary Fund and World Trade Organization) continues to enact policies that do not favor a transition toward sustainable development.

4. Double standards and parallel sets of rules continue to govern international praxis. In the best example, developing countries are under great pressure to open their doors to foreign trade, even as developed countries become more protectionist than ever.

Nonetheless, it is important not to underestimate the impact of the Rio Conference as a wake-up call and a clear point of departure. For example, the idea of sustainable development was discussed extensively during the Conference, leading to a certain international consensus on the concept per se and on the existence of four variables that must be kept in balance if this type of development ever come to exist:

- Social equity.
- Preserving ecological and cultural integrity.
- The pressing need for an ecological paradigms shift.
- The need for civil society to be involved in decision-making.

At the very least, it was agreed that none of these four variables could be sacrificed in favor of the others. In some regards, the Rio Conference left an extremely important legacy, bringing with it:

- New opportunities for cooperation and alliance-building.
- A global, interdisciplinary frame of reference.
- A merging of environmental agencies and intergovernmental institutions.
- Possibilities for ground-breaking debate involving new actors.

Perhaps the most earth-shaking conclusion that can be drawn from the events of recent years is that the paradigm shift and the change of structures will not come about through official action, but as a result of force and pressure exerted from outside the government. The most critical task of the next century will be to merge and interconnect local needs with global priorities. A profound transformation will soon take place in human society and in the global, national and local structures of government. A growing need is being seen everywhere to return to roots, which explains the proliferation of fundamentalism and the heightening of ethnic conflicts. At the same time, traditional government is disappearing with its strong hand, heavy regulations and interventionist powers. It is giving way to a civil society that faces the urgent need to define its legitimacy and seriously consider whether its leaders are truly representative. If such a transformation is to be built on a strong foundation, it must take place from the ground up, eliciting genuine participation from paradigm shift calls for a new local activism, as this is the meeting between society that is best prepared for such a change. By contrast, the most stubborn resistance to real democratization can be seen at global and national levels.
subsystem. Socio-ecological systems may be identified at different scales or aggregate levels, ranging from the smallest, such as a household production unit and the environment with which it interacts directly, to the largest, the entire human race and the ecosphere.

With this type of systems approach, we can identify certain attributes or fundamental properties of agricultural ecosystems that are essential to sustainability in the development of agriculture and renewable natural resources. Such attributes are associated with the sustainability of the agroecosystem as a whole, rather than that of its individual components. The attributes need to be general enough to cover the social and economic components of sustainability, as well as ecological considerations. However, they are also applicable to separate elements of the agroecosystem components, such as technology, soils, etc. Needless to say, all the attributes are not necessarily meaningful when applied to each different component. For instance, any discussion of "empowerment" would be out of order when referring to biophysical components of the system, as "empowerment" relates to enhancing the capacities of the social components.

There are several good reasons for defining system-wide attributes. First of all, the interaction of various elements in a system may be the factor that determines whether a particular component is sustainable or unsustainable. For example, a cultivated field may be inherently unsustainable if considered in isolation, but may actually be quite sustainable when human agricultural management is added to the picture. Secondly, an agroecosystem may be sustainable even if one of its components is not. For instance, shifting agriculture, which can be sustainable so long as certain conditions are met, can be understood as the management of a cycle of interlinked unsustainable processes. Third, a focus on the overall agroecosystem is a useful guide for developing measurable indicators of sustainability which will yield strategic information when changes occur in fundamental attributes of the system. All too often, long lists of variables are offered as indicators of sustainability, but these are purely descriptive variables.

In order for a system to be considered sustainable, it must possess a number of attributes, such as:

- **The supply of resources must remain stable over time**: This attribute is self-evident. It refers to the availability of all resources, whether economic, technological or natural, that play a role in production yield and volume. Such resources could include capital, land, labor, agricultural inputs, environmental conditions, and the like. The type and scale of resources change according to the scale of each socio-ecological system.

- **Adaptability and flexibility (versus rigidity)**: In biological terms, adaptability means the ability of organisms to survive (that is, live and reproduce) under different environmental conditions, or to undergo alterations or adjustments enabling a species, population or individual to improve its fitness for its environment. Human adaptability is defined as the ability of a human system to preserve an adequate quality of life for individuals or communities in a given environment, or even to improve the quality of life.

An adaptable system possesses a certain degree of flexibility; it can be molded or influenced. A rigid system is less able to adjust to a changing environment, and could even produce a collapse of the agroecosystem or certain of its subsystems.

One important step in determining whether the development of agriculture and renewable natural resources is sustainable is to identify the full range of environmental
conditions, both social and ecological, to which a given agroecosystem is suited. These conditions then need to be studied to learn what types of changes they are experiencing, and whether such changes increase or decrease the degree of adaptation of the total system or any of its subsystems.

A number of basic factors determine whether an agroecosystem is able to adapt at different scales, either by adjusting to change in its surroundings or context, or by spreading to new environments. In and of themselves, these factors are important features of the system, and components of the broader concept of “responsiveness,” which will be discussed below.

**Vigor, resilience, and stability (versus vulnerability or fragility):** Technically speaking, the concepts of dynamic stability, resilience and vigor should be handled separately. However, they all refer to the ability of agroecosystems to maintain a certain degree of permanence when confronted with the diverse disturbances that inevitably affect systems of physical existence.

Most human and ecological systems are vigorous. Many wooded areas have recovered from recurrent forest fires, and plant and animal populations withstand heavy pressure in the form of harvest, hunting and fishing. Even human beings survive occasional famine, and societies rebuild from the devastation of war.

However, if a complex system experiences profound disturbance over a long period or in critical areas, it may undergo complete change and acquire a new structure and organization, perhaps remaining stable enough to survive even after the original disturbance has ended. This was the case of climate changes that occurred early in the earth’s geological history, as well as anthropogenic effects in the recent past. An invisible borderline marks the point at which change becomes irreversible. Human activities, through the accumulation of minute changes, bring that crossover point ever closer, and the resulting catastrophe often hits unexpectedly.

**How vulnerable are the different agroecosystems?** The degree and the causes are quite variable. In some cases, vulnerability is inevitable due to the natural fragility of soils; in others, the weak link can be found in the social and cultural fabric that provides basic know-how and essential inputs for the type of production involved. This often occurs when the assault of commercial agriculture sweeps away sustainable forms of production and the wealth of traditional knowledge.

In general, agroecosystems which are highly diverse in both space and time are less vulnerable and more adaptable. In fact, agroecosystems that are widely recognized as sustainable are typically quite diversified in the form of rotations or polycultures.

In a sense, vigor and resilience closely correlate with adaptability because they describe a system’s ability to preserve its identity and integrity in a changing world.

These underlying, often subtle, attributes of complex systems can easily erode without wreaking any noticeable changes in adaptability, until it is too late. Better yet, they can be protected and cultivated, equipping the system to absorb change or even, if conditions merit, to be radically and beneficially restructured.

**Responsiveness:** This attribute reveals the system’s ability to cope with change, whether of external or internal origin. More than passive adjustment, it is an active response to change, reflecting the past history of the system.
The ability of an agroecosystem to respond to change derives from its adaptability and vigor, which are the chief determinants of responsiveness in an ecological subsystem. Human subsystems, somewhat more complex, require other qualities as well. Human responsiveness requires an ability to retain, expand, and wisely use the options available for coping with a social and natural world in constant flux.

Many causal factors determine whether a particular member of a social grouping will be able to respond to change. Such factors include resources available to the group, awareness of problems and opportunities, and the ability to anticipate them, access to information, ability to cooperate, and the like.

Self-reliance: Every self-organized system, with its peculiar form of internal organization and inner dynamics, exercises some degree of autonomy over its own functioning, control over its environment, and influence over the environment of other systems. At every level of aggregation, self-reliance describes the ability of the system to govern its interactions with the external environment. In this context, it is very important for a socio-ecological system to develop mechanisms for bolstering its inner resources so that it can endogenously set its own objectives and priorities and shape its own identity and values. Self-reliance should not, however, be confused with self-sufficiency, or autarky.

The emphasis on self-reliance in no way contradicts the reality of interdependence or the idea of global solidarity. It is, however, incompatible with relationships of domination.

Many examples of impoverishment are associated with a loss of self-reliance, both materially and in the realm of nonmaterial assets, such as cultural and political values, leading to greater dependency on external resources or decisions.

Two very important factors to remember in promoting self-reliance are the ability of the members of society to organize themselves socially, and the limits on the political arena open to them. Both factors are very dependent on the degree of authoritarianism or democracy in a society, and are also associated with the nature of vertical linkages between the socio-ecological system under consideration and the wider system to which it belongs.

Empowerment: Adaptability, responsiveness and self-reliance are all necessary conditions for sustainable development of a socio-ecological system, yet they are not sufficient. In fact, all three attributes are closely (although not exclusively) correlated to the ability to respond to change and regulate the degree of outside influence coming from other systems. In short, they reveal whether the system is autonomous and able to preserve its integrity and identity.

The list would not be complete without adding a final attribute: empowerment. As understood here, empowerment goes beyond the ability of the system (specifically, the human subsystem) to respond to change. Rather, it is the power to innovate and induce change, both within and outside its own walls, in the process of meeting its objectives.

This quality means that the system is able to interact with other systems (farms, production systems, communities, regions, countries) on a more equal footing, and to exercise influence in the pursuit of its own objectives. Empowerment is based on the assumption that the system is already self-sufficient and responsive.

Empowerment shares a strong similarity with self-reliance in that it is heavily
conditioned by the ability of the agroecosystem to organize itself socially, and by many features of the broader society that surrounds it.

By working together and cooperating, farmers from a range of agroecosystems can acquire more power to control their resources and environment. Nevertheless, association among social entities which are very similar may quickly become ineffective. In such cases, it is necessary to develop new types of cooperation that bring together partners representing a wider spectrum of levels of society and interests.

These six system-wide attributes are a consistent grouping that may be useful for exploring nonconventional areas in which research could be necessary. They can also be helpful in evaluating the sustainability of development processes and projects for agriculture and natural resources. For example, would the proposed project make more resources (natural, technological, financial) available to the group, community or region? For most development projects, the answer to this question will be "yes." Much less obvious is whether the project would improve or worsen the stability of the resource supply, or the level of adaptability, vigor, responsiveness, self-reliance and empowerment. While many agricultural development projects would certainly produce an increase in resources, they can also raise the system's dependency on external inputs, limit the number of options and reduce responsiveness. These effects certainly cast doubt on the sustainability of the project. Simply posing such questions may show the way to new and more effective solutions, and it demonstrates the need for indicators of sustainability with which to perform a specific analysis of the performance of systems of natural resource use (see Box 2).

Finally, it is important to emphasize that, while these attributes indicate whether a system is likely to last, they say nothing about whether the system is actually desirable. Any system needs to be evaluated, first and foremost, according to the basic values outlined in the previous section; only then it is appropriate to discuss whether the system will be able to sustain over time.
### BOX 2

**Criteria for Diagnosis and Indicators of Sustainability in Natural Resource Management Systems.**

<table>
<thead>
<tr>
<th>General principles of sustainable agriculture</th>
<th>Areas of evaluation</th>
<th>Criteria for diagnosis</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Productivity</td>
<td>- Technical and environmental management</td>
<td>- Efficiency</td>
<td>- Yield (changes over time); energy efficiency,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Species in use; multicropping; rotations.</td>
</tr>
<tr>
<td>- Equity</td>
<td></td>
<td>- Renewable resources</td>
<td>- Soil and water quality; flow/stock ratio; agrochemical contamination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Self-reliance</td>
<td>- Dependency on external inputs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- System fragility</td>
<td>- Incidence of pests and diseases.</td>
</tr>
<tr>
<td>- Economic</td>
<td>- Efficiency</td>
<td></td>
<td>- Cost / benefit ratio, investment (in S and labor).</td>
</tr>
<tr>
<td>- Sustainability</td>
<td>- Diversified</td>
<td>- Diversified production</td>
<td>- Crop diversification, integration of production and marketing.</td>
</tr>
<tr>
<td>Stability</td>
<td>- Risk distribution</td>
<td></td>
<td>- Access to insurance and other mechanisms.</td>
</tr>
<tr>
<td>Resilience</td>
<td>- Employment</td>
<td></td>
<td>- Labor demand / displacement.</td>
</tr>
<tr>
<td>Reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptability</td>
<td>- Distribution of costs and benefits</td>
<td>- Number of beneficiaries by ethnic group, gender, social group.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Participation</td>
<td>- Involvement of beneficiaries in different phases of the project.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Self-determination</td>
<td>- Local control over the system; degree of organization.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use of local knowledge</td>
<td>- Critical rehabilitation of practices / methods / forms of organization.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Learning process</td>
<td>- Local adaptation of proposed systems.</td>
<td></td>
</tr>
</tbody>
</table>

Taken from Masera, 1995. This table gives a very general outline of indicators, for purposes of illustration. All these indicators are not necessarily relevant to every project; similarly, specific projects may call for important indicators that are not included in this table.

**Indicators of sustainability for natural resource management systems.**

One of the greatest challenges for the debate over sustainable development, particularly in the case of sustainable agriculture, is to design operating frameworks that contain indicators for evaluating the sustainability of different projects, technologies or agro-ecosystems.

Several alternatives have recently been proposed as conceptual frameworks for preparing sustainability indicators. They range from macro-regional evaluation (Winograd, 1994) and soil-management studies (Gemas and Dananaki, 1994) to natural resource management systems (de Camino and Mühler, 1993; Masera, 1994) and frameworks designed for specific projects (Nair, 1993; Taylor et al. 1993).
There is no one definition of sustainability, and similarly, there is no single framework for indicators. Concrete indicators continue to depend on the particular characteristics of each specific problem under study, the scale of the project, types of data available and access to them, and the like. In short, there are no universal indicators.

A framework of evaluation needs to be internally consistent. It should include sustainability indicators that (i) are based on the fundamental principles of sustainable development (productivity, equity and sustainability, the latter can also be broken down into the four basic principles of stability, reliability, resilience and adaptability); (ii) delineate the problem under study (such as objectives and characteristics of the management system being evaluated); (iii) apply the general principles of sustainability, using diagnostic tools tailored to the specific problem; (iv) yield concrete indicators for measuring or estimating the diagnostic tools selected.

The concept of sustainable agriculture correlates environmental issues with socioeconomic concerns. It is important, therefore, for indicators to cover all dimensions or areas of evaluation: technical-environmental, socio-cultural and economic. As described, this procedure clearly links indicators and diagnostic tools to principles of sustainability, thus avoiding the need for endless lists or spurious indicators.

The evaluation system will be truly workable if the proposed indicators are integrated, or provide summarized information on various important attributes of system. Indicators should be easy to measure and monitor, and appropriate to the level of aggregation of the system under study. Finally, they should preferably be applicable to a wide range of ecosystems and socioeconomic and cultural conditions (Torquemada, 1980, as cited in de Camino and Müller, 1993). The list of indicators need not be exhaustive; rather, it should include only those points that have a critical impact on the problem of interest.

The table gives a general model of diagnostic tools and concrete indicators that normally figure in the evaluation of systems for managing natural resources according to the principles of sustainable agriculture. Specific case studies can be found in literature available on the subject. The most important criteria for diagnosis have been divided into three sections, according to the principles they measure. Criteria for the principle of productivity are efficiency (in terms of economic returns and resource management) and renewability in resource management. The principle of stability is reflected in the diversity of production strategies, crops and species. Finally, the principle of equity can be seen in the distribution of costs and benefits, and the participation of beneficiaries. The most important point is that every criterion of diagnosis is specifically related to at least one of the general principles.

The right-hand column gives concrete indicators, classified by area of evaluation. For example, the technical-environmental evaluation includes criteria of efficiency, whose indicators are yield and energy efficiency in the system. The criterion of diversity is measured using as indicators the number of species in production, multi-cropping, and the use of crop rotation. The third criterion, renewability of resources, lists several indicators, indicators, including water and soil quality. The first criterion for the economic evaluation is efficiency, which naturally uses such indicators of profitability as such cost-benefit ratio, net present value, and internal rate of return. Diversification of risk can be measured by the presence or absence of insurance, and the like. The third area of evaluation is socio-cultural, and includes such criteria as participation, estimated in terms of the degree to which beneficiaries are involved in the different phases of system development. Self-determination (or self-management) can be judged by the amount of local control over the system and the degree to which participants are organized. The same process is followed for the remaining criteria.

Once information has been compiled with the different indicators, it is possible to draw comparisons of the sustainability of different natural resource management systems. Depending on the objectives of the analysis, numerical values can be assigned to various indicators, and management systems can be ranked (using such techniques as factor analysis). The results could also be presented in graphical or semi-quantitative form, such as the types of diagrams developed for methods of participatory evaluation.
3. AGRICULTURE AND NATURAL RESOURCES IN THE AMERICAS

This chapter will give a general assessment of agriculture in the Americas. Following an eco-geographic description, it will discuss the renewable natural resource base in different sub-regions of the Americas, and close by describing the current state of agriculture per se and of rural populations.

3.1 The eco-geographic setting

Rural production is largely subject to the characteristics of natural areas where it takes place. The most important environmental factors are climate (rainfall, temperature, solar radiation, winds, etc.), topography and substrate (soil type and quality).

Latin America and the Caribbean form a region of nearly 40 political units that blanket over 20 million square kilometers of land and boast a complex mosaic of landscapes, each with a unique resource potential. The region stretches from above 30° latitude north to 55° latitude south and contains an extraordinarily wide variety of environments, ranging from the typically nearctic landscapes of central and northern Mexico, to the truly antarctic and subantarctic lands in the southern tip of Chile and Argentina.

The region as a whole contains physical features similar to those found elsewhere. At the same time, and even more important, it is home to natural phenomena that exist nowhere else on the face of the earth. It is these eco-geographic peculiarities that provide an explanation for certain biological, ecological and cultural phenomena and patterns that are unique or specific to the region. The first defining feature is the South American continent itself. Of all continental land masses, it is here that the Southern Hemisphere attains its southernmost latitudes, as measured from the equator (over 50° latitude south). This, added to the extensive northern portion of the continent, makes South America a vast land corridor.

Another distinguishing feature is that Latin America, the most humid continent on the planet, is home to highly arid zones, including the Atacama, the world's driest desert. Overall, average annual rainfall in the region exceeds the world average by 50 percent, producing an estimated 370,000 m³ per second in mean annual runoff, or approximately 30 percent of all the surface water that empties into the world's oceans. As a result of this rainfall, the region also contains the most extensive mass of tropical humid vegetation in the world. This is the key to its vast biological riches, with the greatest diversity of plant and animal life in the world.

Of all the region's structural features, it is topography that most dramatically highlights the contrast among the four subregions. A careful study of any map clearly reveals the vast differences between Mexico and Central America on one hand, and the South American subcontinent, on the other. Most of the land in South America lies at elevations below 100 m. Notable exceptions are the highlands of Guyana and Venezuela, Southeastern Brazil and of course, the Andes, the world's longest mountain range. Otherwise, this portion of Latin America is essentially a vast, flat plate stretched out at low altitude. Mexico stands in striking contrast, with mountainous terrain covering nearly the entire country. Over 50 percent of the
land in Mexico lies above 1000 m, and over 65 percent, above 500 m. The situation in Central America is even more pronounced, Belize being the only exception. Over 75 percent of the land in the countries of the isthmus is mountainous, consisting of ranges, plateaus and hillsides. Mountains in the Caribbean are of a slightly different nature, in keeping with the subregion’s inland topography. The highest elevations in the region can be found in the central Andes, the northern portion of Central America (Guatemala), and Mexico along the string of mountains rising above 4000 m, known as the Neovolcanic Axis. The relief map also shows two broad highland areas in the region: one in north-central Mexico, with altitudes between 1,000 and 2,000 m, and a higher one in the central Andes (Peru, Bolivia, Chile and Argentina), with altitudes above 3,000 m.

The final point of interest is hydrology, or the distribution of inland waters. South America contains the largest river networks, and Mexico and Central America are dotted with lakes; but rivers are negligible in the Caribbean. The major inland movements of water take place in the South American continent, where rivers account for over two-thirds of the region’s total runoff. Most of the rivers in Latin America empty into the Atlantic and the Caribbean, with only a small proportion of the water draining into the Pacific.

In summary, topography and hydrology are the two defining characteristics of this region. Mexico and Central America are identified with mountains (and volcanoes) and lakes, the Caribbean with the sea, and South America with rivers and plains or with snowcapped mountains (in the Andes). However, the identification of landscapes along the length and breadth of Latin America is a task more complex than merely classifying geographic features. Topography and hydrology are merely the basic geographic cornerstones on which the region’s tremendously heterogeneous environment is built. They are the roots of the wide climatic, ecological and biological diversity found here. Topography, hydrology, climate, and ecological and biological diversity, in turn, derive from the age-old process by which the region was formed. Indeed, it is the product of a natural history both unique and specific.

Continuing north past Mexico, the United States covers a territory that measures over 49,827,000 square kilometers. Geographic patterns of topography, climate and vegetation are well defined. Mountains are limited to the western third of the country (the Rocky Mountains and the Sierra Nevada) and the southeast (the Appalachian). Vast, high plains cover much of the central zone, and coastal plains predominate along the Gulf of Mexico and Atlantic seaboard. This, together with climate, has favored the growth of a broad swath of forestland along the Pacific coast and in much of the east, from Texas to Louisiana and all the way to the Canadian border. The semiarid scrubland and desert growth found all along the Mexican border stretch northward in the west, almost to Canada. Wide grasslands blanket most of the central zone, covering nearly one third of the country.

In such an environment, farming and ranching have flourished, encouraged by the seemingly unlimited supply of flat land, a favorable climate, and a great abundance of surface water and groundwater. Grain production, beef cattle and dairy herds cover much of the semiarid and subhumid agricultural zones, while orchards, vegetable farms, cot-
ton, tobacco and even rice plantations can be found in more human areas, such as the California coast and the Eastern seaboard all the way to Florida.

Canada is located above the fiftieth parallel. At such a latitude, low temperatures are the chief constraint for human settlement and primary production. Consequently, the population and primary production activities are clustered along the southernmost strip of the country. Although Canadian territory is vast, low temperatures hinder the survival of crops, and farming and ranching activities can take place on only a small share of the land. Between Calgary and Winnipeg lies an exceptional geographical enclave of prairies and steppes, a strip that narrows as it extends northward. This area specializes in grains (wheat, oat and barley) and goats. Cattle are raised along the Atlantic coast, from Toronto to Quebec. The rest of the country is covered by extensive woodlands which have fed a vigorous forestry industry.

3.2 Agroecological zones

The hemisphere can be divided into clear agroecological units based on several different factors. One is the growing season, defined as the number of days per year when plants, whether wild or domestic, can grow, given the combination of rainfall and evapotranspiration potential in a given area. Another important determining factor is latitude. Together, these factors form a synthesis of the environment and define the full range of potentials and constraints for agricultural production.

Fourteen agroecological zones can be identified in Canada, and 20 in the United States, based essentially on climate (see Box 3). The United States claims a variety of agroecological zones that range from dry and cool to hot and humid. As was explained above, Canada's farming and livestock activities are limited by climate to the southernmost area.

Throughout Latin America, agroecological zones generally coincide with the major environments or biomes. They are fairly easy to identify on the basis of vegetation, which ultimately is a synthesis of such factors as climate, soil, hydrology and topography. Five main agroecological zones stand out in Latin America and the Caribbean. The humid tropics cover 34 percent of the region and contain tropical forests with tall to mid-height trees. The subhumid tropical and subtropical zones, covering 11 percent of the land, are characterized by savannas, pampas and other types of vegetation. The semiarid tropics and subtropics consist mainly of scrubland and account for 14 percent of the area. Eleven percent of the region is wetlands, under temporary or permanent flooding. Finally, the mountains make up 18 percent of the area and consist mostly of the Andes and much of Mexico and Central America. These five agroecological zones are distributed unevenly through the countries. Each poses its own types of environmental constraints, and in fact, only 3.4 percent of the total region offers optimal conditions for agriculture (see Boxes 4a and 4b).

3.3 The agrarian structure

The agrarian structure in Canada and the United States is vastly different from that of the great majority of places in Latin America, notwithstanding striking similarities exist
AGROCLIMATIC ZONES IN THE UNITED STATES AND CANADA

This agroclimatic zone classification was based on:

1. When temperatures fall below 0°C, most important crop according to land surface area, other important crops, most important livestock activity; types of land management, structure of production, soil depth and texture, planting intensity, and length of growing season.

2. United States

A - Northwest
B - Northwest wheat and range
C - California
D - West range
E - Rocky mountains
F - Northern Great plains
G - Western Great plains
H - Central Great plains
I - I
J - Southwest prairie
K - Northern lake states forest
L - Central feed grain
M - Eastern and central crops and forests
N - Mississippi
O - South Atlantic
P - Northeastern forage
R - Northeastern forest
S - North Atlantic
T - Atlantic Gulf
U - Florida

### MAJOR AGRO-ECOLOGICAL ZONES OF LATIN AMERICA AND THE CARIBBEAN

<table>
<thead>
<tr>
<th>Agro-ecological zones</th>
<th>Principal climate</th>
<th>Soil / climate</th>
<th>Major limitations on agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humid tropics</td>
<td>Tropical (monthly mean temperature corrected to sea level above 18 °C)</td>
<td>More than 9 months growing period</td>
<td>Prevalence of acid, low-fertility soils, Major pressure from insects and plant disease. Poorly developed transportation, storage and market infrastructure.</td>
</tr>
<tr>
<td>Subhumid tropics and subtropics with acid soils</td>
<td>Tropical and subtropical (one or more months with temperatures between 18 °C and 5 °C)</td>
<td>6 to 9 months growing period; acid soils</td>
<td>Low soil fertility. Acid soils with potential for P fixing. High level of inputs required for most crops. Low nutrient retention in soil.</td>
</tr>
<tr>
<td>Semiarid tropics and subtropics</td>
<td>Tropical and subtropical (one or more months with temperatures between 18 °C and 5 °C)</td>
<td>3 to 6 months growing period</td>
<td>Growing period too short for crop to develop unless irrigated. High risk of unexpectedly long dry spells. High water use by irrigated crops.</td>
</tr>
<tr>
<td>Wetlands</td>
<td>All climates</td>
<td>Soils saturated with water for over 60 days</td>
<td>Poor drainage affects non-tolerant crops. Some areas may remain flooded part of the year.</td>
</tr>
<tr>
<td>Areas with no major limitations</td>
<td>Tropical, subtropical, temperate</td>
<td>More than 9 months growing period. No major physical or soil- quality constraints.</td>
<td>No major soil or climate limitations, although unexpected droughts may affect agriculture.</td>
</tr>
</tbody>
</table>

# DISTRIBUTION OF AGRO-ECOLOGICAL ZONES BY SUBREGION

<table>
<thead>
<tr>
<th>Region</th>
<th>Humid tropics</th>
<th>Subhumid tropics and subtropics with acid soils</th>
<th>Subtropical and subtropics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (ha × 000)</td>
<td>% of total region</td>
<td>Area</td>
</tr>
<tr>
<td>Andes</td>
<td>162,730</td>
<td>35.5</td>
<td>48,739</td>
</tr>
<tr>
<td>Brazil</td>
<td>496,995</td>
<td>52.5</td>
<td>143,045</td>
</tr>
<tr>
<td>Caribbean</td>
<td>51,993</td>
<td>71.7</td>
<td>4,397</td>
</tr>
<tr>
<td>Central America</td>
<td>28,929</td>
<td>59.2</td>
<td>10,225</td>
</tr>
<tr>
<td>Mexico</td>
<td>7,290</td>
<td>3.7</td>
<td>14,175</td>
</tr>
<tr>
<td>Southern Cone</td>
<td>0</td>
<td>0.0</td>
<td>14,042</td>
</tr>
<tr>
<td>Total LAC</td>
<td>747,897</td>
<td>34.4</td>
<td>234,623</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Wetlands</th>
<th>Steep slopes</th>
<th>Areas with no major limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andes</td>
<td>60,269</td>
<td>148,595</td>
<td>13,470</td>
</tr>
<tr>
<td>Brazil</td>
<td>98,796</td>
<td>10,234</td>
<td>22,504</td>
</tr>
<tr>
<td>Caribbean</td>
<td>7,838</td>
<td>8,907</td>
<td>5,068</td>
</tr>
<tr>
<td>Central America</td>
<td>8,349</td>
<td>14,664</td>
<td>5,468</td>
</tr>
<tr>
<td>Mexico</td>
<td>11,709</td>
<td>49,125</td>
<td>2,708</td>
</tr>
<tr>
<td>Southern Cone</td>
<td>63,923</td>
<td>68,356</td>
<td>24,274</td>
</tr>
<tr>
<td>Total LAC</td>
<td>250,884</td>
<td>398,881</td>
<td>73,492</td>
</tr>
</tbody>
</table>

Source: FAO

Note: Percentages have been calculated on the basis of total area in the region, including land not suitable for agriculture. Area percentages do not add up to 100 for two reasons: (i) the table does not include nonagricultural land such as deserts, and (ii) areas are not always mutually exclusive, so that more than one type of zone may consist in a single area.

between these two countries and some parts of Mexico, Brazil, and above all, Argentina and Uruguay. The agroindustrial model holds absolute sway in Canada and the United States, where only three percent of the total labor force works on farms. In Canada, 318,000 production units averaging 208 hectares of land each, cover seven percent of the territory, or 66 million hectares. In the United States, 2.1 million units, averaging 187 hectares, cover nearly half the country, or over 400 million hectares. Two clearly differentiated types of
production units continue to coexist in that country: fifteen percent of the total are true
business operations and generate approximately 85% of all food, raw materials, and primary
goods; family farms obtain most of their income from non-primary activities, supporting
themselves by selling their labor off the farm. The rural or primary sector in these countries
has adopted technologies to boost yields by improving labor and land productivity, thus
becoming an exporter of foodstuffs and other goods.

The situation in Latin America is very different. First of all, some 26 percent of the
region’s economically active population is engaged in primary activities. The region thus
holds an intermediate position between typically agrarian economies such as those found
in China, India or the countries of Africa, where 60 percent or more of the economically
active population works in primary activities, and industrialized countries, where the
figure is less than eight percent. This is because of the dual nature of agriculture in Latin
America. Some geographic areas offer environmental conditions particularly favorable to
the agroindustrial model, and the orientation has been increasingly toward big agricultural
business. Elsewhere, as in the mountains or wherever the soil conditions and climate,
especially rainfall, are more marginal, peasant farms continue to be the norm. At the same
time, small- and large-scale cattle ranches have been strongly expanding into the flat areas
of tropical humid and subhumid zones, and employ very little labor.

Nonetheless, in most of the countries, the peasant farm, defined according to plot
size, continues to be the model of choice, based on the number of production units, al-
though not in terms of total land in use. Small holdings account for 40 to 50 percent of all
farm production units in Brazil, Chile, Costa Rica and Venezuela, 60 percent in Colombia,
and more than 70 percent in Mexico, Peru, El Salvador and Ecuador. Over half of all
cultivated land in the majority of the countries, however, is under the agroindustrial model,
which supplies 56 percent of the domestic market (versus 41 percent from the campesino
sector) and 68 percent of export production, compared to 32 percent by peasant farms.

3.4 Socio-environmental trends

The role of agriculture: Although the relative weight of primary agricultural production
and the rural population tends to decline over time, both continue to play an important
role in the societies of the Americas.

The agricultural sector produces approximately one third of all exports from Latin
America and the Caribbean (LAC) and a large share of total exports from the United
States and Canada. The 1980s witnessed a widespread decline in international prices for
agricultural products, and the region was obliged to seek major expansion in the volume
of exports in order to gain even small improvements in total export value.

Farm producers have been hit by low international prices for their products in recent
years, coupled with rising exchange rates, heavy competition from imported goods as trade
barriers have toppled, and relentless price increases. At the same time, they have lost much
of the preferential credit facilities they once enjoyed. For the most part, recent economic
policies have been detrimental to the agricultural sector.

Although the rural population in LAC has held steady at about 120 million since
Two Models for Organizing Agricultural Production

Formal Employment Model

- Labor and management completely separate
- Centralized organization
- Emphasis on specialization
- Emphasis on business considerations in agricultural practices
- Predominance of wage labor
- Technology designed to eliminate spontaneous decision-making in the field or on the spot
- Labor-saving technology
- Heavy dependence on purchased inputs

Family Employment Model

- Labor and management closely interwined
- Owners directly responsible for managing production process
- Emphasis on diversification
- Emphasis on durability of natural resources and quality of life
- Wage labor is supplementary
- Spontaneous decision-making, apppriate for highly unpredictable production process
- On-site decision-making guided by specific needs of production process
- Emphasis on use of on-farm or local inputs

Agriculture based on the formal employment model drafts wage labor, both temporary and in a few cases, resident, overseen by a foreman and directed by managers. It tends toward heavy concentration of income and accentuates exclusive social caste structures. The family employment model, by contrast, has an essentially distributional profile and offers incomparably better sociocultural conditions. Family-based organization of agricultural and forest production is also immeasurably more desirable for the full matrix of sustainability (including stability, resilience and equity), because the system is very flexible, production tends to be diversified, and decision-making processes are much more maneuverable.

1950, as a share of total populations it has declined from 60 percent to 29 percent in the same period. Meanwhile, total population grew from 286 million to 448 million from 1970 to 1990. Thus, Latin America's impressive gains in agricultural output were not matched by an increase in per-capita food production.

United States, Canada, Argentina and Uruguay: The United States, Canada, Argentina and Uruguay have agricultural sectors markedly different from those of other subregions of the Americas. These areas contain around three-fourths of all cultivated land in the region, and their small rural populations put out more than 90 percent of all grain production. They are home to highly mechanized large- and medium-scale commercial farms that hire relatively little wage labor. Barely three percent of the total labor force in the United States and Canada is employed on farms. These countries have no agricultural frontier, their forest areas are either stably low or growing, and the number of small producers has been declining steadily.

Perhaps the practice that most distinguishes farming systems in the United States from those in the Southern Cone is reliance on agrochemicals. The United States registers very high levels of fertilizer and pesticide use, although a declining trend is visible in an emerging organic farming sector; Southern Cone countries use low levels of fertilizers
and pesticides, but the trend is upward. All these countries exhibit heavy increases in farms using minimum tillage or zero tillage systems which require fertilizers and herbicides.

The greatest change in land use in Argentina, Uruguay and southern Brazil over the past twenty years has been the increase in acreage planted to soybeans, and to a much lesser extent, wheat. The process, known locally as “agriculturation,” consists of large scale monocultures replacing traditional rotations of crops and livestock, with very damaging consequences on soil and general biodiversity.

**Big-business agriculture in tropical America. Chile and the English-speaking Caribbean:** Large agricultural business operations in these countries are very different from those commonly found in the United States, Canada and parts of the Southern Cone. They generally employ large contingents of temporary wage labor and produce crops with a high value per unit of land. A similar pattern can be found in the southeastern region of the United States. These businesses typically produce cotton, poultry, coffee, sugar cane, flowers, fruits, vegetables, ornamental plants and irrigated grains. With the exception of coffee, almost all these crops are grown in lowlands where agroecological conditions are ideal. Production systems favored by this sector are based on heavy use of chemical inputs and the labor of seasonal workers who often live under extremely trying conditions and grapple with myriad employment, wage and health problems.

Many changes have occurred in this sector, although the trends vary from one product or country to another. The 1980s were a time of heavy growth in citrus production in Brazil, flowers in Colombia and Costa Rica, fruit production and forestry in Chile, vegetables in northern Mexico, melons in Central America, pineapple in Costa Rica, Honduras and the Dominican Republic, and ornamental plants in Costa Rica. Nearly all the banana exporting countries of Latin America expanded production in this sector, and industrial poultry production grew rapidly throughout the continent. One result has been an increase in the population of landless farm workers in countries such as Chile, Costa Rica, Colombia and Mexico.

Traditional products such as cotton, coffee and sugar cane had registered rapid growth in the 1970s, only to suffer major setbacks in the 1980s and early 1990s, due to low international prices and the loss of preferential market access mechanisms. Similar problems affected banana producers in the Caribbean.

With growth in big-business agriculture, the use of agrochemicals continued unabated during the 1980s. This sector is highly vulnerable to the full range of problems associated with overuse of pesticides, including higher tolerance levels in pests, residue levels too high for export, soil and water pollution and poisoning of farm workers.

**Subsistence farms:** From 54 to 67 percent of the rural population of Latin America and the Caribbean (LAC) is poor, and about half of all poor households live below the poverty line. Rural poverty in the region is heavily concentrated in central and southern Mexico, hillside areas of Central America and the Andes, northeastern Brazil, Haiti and the Dominican Republic.

From 1980 to 1990, the number of small subsistence farms increased by 47 percent, from 7.9 million to 11.7 million. Although these farms represent nearly 70 percent of all agricultural units in LAC, they control only 3.3 percent of all farmland. Typically, most of the land in subsistence zones is owned by medium- and large-scale livestock operations practicing extensive production systems.
AGRICULTURE IN THE UNITED STATES: CONVENTIONAL SYSTEMS AND AN ALTERNATIVE APPROACH

Conventional agriculture

- Singlecropping
- Specialized genetic stock
- Single harvest in succession
- Farming separate from livestock production
- Standardized production systems

- Specialized high-input technology
  - Highly specialized science and technology
  - High consumption of chemicals
  - Vertical transfer
  - Capital-intensive technology

- Priority on profit, quantity, speed
- Based on competition and individual interest
- Denies tradition and culture
- Agriculture is just a business
- Exploited, low-wage labor

- Highly dependent on external inputs
  - Nonrenewable energy sources
  - High consumption
  - Market dependence

- Centralized
  - National and international production and marketing
  - Concentrated control of resources and capital
  - Less human labor, more agro-processing

- Control and exploitation
  - Production maintained with chemicals
  - Highly processed foods
  - Little or no recycling

- Neo-liberal economic model
  - Emphasis on agricultural export
  - Reductionist, specialized approach
  - High consumption, material growth

Alternative agriculture

Agro-ecology

- Species cropping
- Diversified genetic stock
- Multiple harvests in rotation
- Farming and livestock integrated
- Production systems adapted locally

Technology

- Systemic technologies
  - Interdisciplinary science and technology
  - Generally low consumption of chemicals
  - Horizontal transfer (sharing)
  - Labor-intensive technology

Economic and social

- Priority on quality and permanence
- Based on cooperation and community interest
- Preserves tradition and culture
- Agriculture is a way of life
- Good working conditions and wages for labor

Dependency

- Low dependence on external inputs
- Renewable energy sources
- Community self-reliance
- Based on local foodstuffs

Management

- Decentralized
  - Local and regional production and marketing
  - Widely spread, equitable control over resources and capital
  - More human labor

Relationship to nature

- Cooperation
  - Production maintained through healthy soils
  - Natural foods, minimal processing
  - Recycling is managed and regulated

Development model

- Neo-liberal model under question
- Emphasis on national and local
- Holistic, integrated approach
- Neo-liberal model under question
AGRICULTURE IN THE UNITED STATES: CONVENTIONAL SYSTEMS AND AN ALTERNATIVE APPROACH

The conventional paradigm has ruled agriculture in the United States and Canada in recent decades. Having originated in the countries of the North, and based on reductionist scientific principles and theories, it has now spread southward, replacing other forms of agriculture. It is characterized primarily by high outlays on capital and technology, standardization, homogenization, high levels of mechanization, a social labor hierarchy, and frequently, an export orientation. This model perfectly fits the vertical, top-down approach to agricultural technology generation, which assumes that western scientists working for international or national research institutions carry out basic research and technology generation by conducting experiments. In theory, the resulting technology is transferred (usually in the form of "packages") to national and regional research centers, which then test it under local conditions and then disseminate it to farmers through extension systems. In this model, scientists are farmers as passive recipients of technological packages.

The alternative agroecological paradigm, based on principles of ecology, pursues objectives such as social equity, relief of hunger stresses by producing for local markets, and greater recourse to "traditional" indigenous agricultural practices (although it does not reject the modern science of agro-ecology). The agroecological approach defends the role of horizontal and self-management forms of technology generation and development, in addition to or instead of traditional vertical strategies. It also values and defends the use of local indigenous knowledge and encourages experimentation, change, and interaction among farmers, researchers, and extension agents.

Several efforts to reconcile the two models have begun to appear, in the United States in the guise of "sustainable agriculture." Although sustainability generally upholds the same "philosophy" as the alternative approach, a growing number of conventional and institutional producers are now adopting some of the ideas promoted under the rubric of sustainability. Even with such efforts, a wide gap continues to separate the two approaches, partly because proponents on both sides lack information about one another, and because of the abundance of myths about the advantages of alternative agriculture. These "isms" are a constant source of conflict. While defenders and practitioners of alternative agriculture squabble over the conventional approach and its users, conventional institutions and scientists remain skeptical of the alternative paradigm and even challenge it outright. Much of the challenge simply lies in overcoming these "isms".

Indigenous families make up around one quarter of all rural households in Latin America. Of these, 80 percent live in Mexico or the Andean region, where rural poverty is rampant among indigenous populations.

Subsistence farms usually practice diversified survival strategies, combining a variety of food crops and animals with off-farm and on-farm sources of income. In many cases, remittances from family members working outside the community also play an important role. This sector used very few agrochemicals in the 1960s, but levels rose sharply in the 1970s. This was followed by a decade of economic crisis that prompted a number of different responses, including withdrawal in input use.

As economic hardship and environmental degradation worsened during the 1980s, rural poverty rose and farm wages declined in zones occupied by subsistence farms (FAO, 1988). Populations swelled and average farm size shrank. Deforestation and soil erosion
intensified, causing difficulties for producers themselves and worsening the situation of reservoirs and rivers.

**Small-scale commercial producers in the tropics:** Not all smallholders in LAC are subsistence farmers. In the early 1990s, an estimated four million commercial smallholdings controlled 9.1 percent of all farmland and probably contributed about one third of the region’s agricultural production. Typically, these are farmers who have managed to accumulate a bit of capital due to a combination of fortuitous factors. They may own land located in desirable agroecological zones or near large urban markets. Some have received land grants through agrarian reform programs or have preferential access to credit and other public services. They produce a wide variety of items, although there is a tendency to focus on high-valued products such as cotton (particularly in Paraguay), bananas (in the Caribbean), coffee, sugar cane, vegetables and dairy products. They use little farm machinery and some agrochemicals, and usually improved crop varieties.

Only fragmentary information is available on trends in this sector over the past 15 or 20 years. Certain subgroups, such as vegetable producers in Chile and Guatemalan coffee growers in Honduras, were able to seize new market opportunities and profit from higher nominal prices triggered by currency devaluation in the 1980s. These are the groups that have benefitted the most from the growth of nongovernmental organizations and farmer organizations in many countries. Other subgroups have been faced with problems of competition from imported foodstuffs, cutbacks in public services, low international prices for their traditional exports, and slack domestic demand for food, as a consequence of the economic crisis.

**The Agricultural Frontier:** Latin America still has more forest cover than any other region in the developing world. Even so, forestland is disappearing at a rate of four percent per year. From 1968 to 1986, total forestland shrank from nearly 1.1 billion hectares to 947 million hectares. The Amazon Basin, which holds the majority of the forests, is also the site of most of the deforestation, and the same trend can be observed in southeastern Mexico and Central America, although to a lesser degree.

The forests of the humid and subhumid tropics are the birthplace and home of numerous indigenous groups whose systems of production and gathering have remained sustainable for many years. However, these lands have been subjected to encroachment by squatters, whose predatory production methods tend to favor extensive cattle raising and short follow slash-and-burn systems for food production. Under such intensive methods, ecosystems cannot recover. From 1968 to 1986, 35 million hectares were added to Latin America’s total grasslands, mainly in these areas. Other production methods, of lesser importance, include extractive systems, perennial crops, narcotics crops and forest utilization.

The concentration of land ownership at the agricultural frontier varies from one place to another. Even so, because land is relatively easy to obtain in these areas, the population of landless farmers and subsistence units is small. Public services and infrastructure are generally deficient, but poverty levels are usually lower than in areas where subsistence farming is the norm.

In the 1970s, Brazil and the countries of Central America promoted a variety of incentive policies, public investments in infrastructure, and land tenure programs under which forests were converted to grassland, and large areas were settled. Starting in 1987 in Brazil and the early 1980s in Central America, some of the governments began to backtrack on their pro-livestock policies, and there is reason to believe that deforestation rates, although still high, began to decline.
4. ROOT CAUSES OF THE AGRICULTURAL CRISIS

Many problems were described in the previous sections: environmental degradation, poverty, and limited ability of farmers and their agroecosystems to adapt to environmental change. All stem directly from common processes, biased policies, institutional systems, technologies, and power structures; these, in turn, are the result of an inappropriate view of development (see Box 7) which gives a predominant role to market forces.

The market on the other hand has only a limited ability to trigger behaviors that will encourage sustainability among the various sectors of society. Indeed, under modern-day structures, most markets actually generate and reward perverse behaviors that hinder progress toward sustainable development. Thus, in seeking new alternatives, it is useful to question the role of the market concept itself. Has the market ceased to be a legitimate institutional mechanism for allocating resources? Or does the real problem lie in the prevailing types of markets?

Markets are not abstract, generic phenomena, but a combination of heterogenous institutional mechanisms, each with its own specific participants, location, duration, operating rules, and ways and means to enforce contracts. Markets do not exist in a vacuum, but are created entities. Their operations are shaped by previously established definitions of property relations, limits set by governments and by the market's own organizations, traditions and behaviors of participants, and the concrete technology used for conducting transactions. All these factors help determine whether the specific operations of the market are compatible with sustainable development. Thus, as will be seen later in more detail, the problem is not so much whether or not markets should exist, but whether the concrete market structures that have evolved and the policies, institutions and technological patterns that guide them are appropriate.

4.1 Globalization and economic opening in the absence of social control

The legendary fall of the Berlin Wall marked the end of the age of cold war, a time marked by ever-present ideological, trade and military clashes. The world unexpectedly found itself in a post-war age overrun by regional conflicts among countries and ethnic groups, for which the international community was ill-prepared. As the millennium draws to a close, the entire world is living through an extraordinary process of change. The idealism of an alternative development model has been pushed aside by the reality of consumerism, militarism and an avalanche of empty images, all of which has ushered in a profound crisis of values for individuals, families and entire communities.

Today's world is overshadowed by the specter of "globalization," a process which is baffling to the general public. In the neoliberal version that has swept the Americas, the focus has been on free markets, competitiveness and efficiency,
consumerism, and a short-term mentality, regardless of any implications for the quality of life and natural resources. The process is widening the breach in a world that has been split into two camps: those who are included and those who are not. The rift between rich and poor, visible both globally and nationally, is widening, and the weakening the public sector, government services and collective values is evident.

In order to offset the results of this structure and provide some relief, the wealthy countries came up with the idea of development assistance or international cooperation. It has become obvious, however, that today's development assistance programs have responded more to political and trade concerns than to the real developmental needs of poor countries. The flow of international cooperation is becoming more constricted, both in absolute terms and by comparison with the flow of private financial transactions. Every day, the world’s financial markets handle a flow of private capital approximately 50 times greater than the annual sum of all development aid.

Today's capital is highly mobile, and the transfer of technology and information has become nearly instantaneous and unhindered by any social structures. As a result, local communities and even nation-states are losing all control over their own destinies. Capital, knowledge and technology, no longer under government dominion, have been privatized, transnationalized and deregulated. Financial systems have responded by becoming highly unstable, and the world economy itself is at risk.

Many of the countries in this region have elected to build up the secondary and tertiary sectors of the economy, resorting to costly imports to keep up the food supply. The result is further displacement of the rural population and an explosion of urban problems.

In this setting, the Americas have unquestionably begun to consolidate as a block. For better or for worse, the United States and Canada have recognized that their economies are closely interdependent with those of Latin America, and they are finding ways to use this region as a counterweight to the rising tide of economic and political power in the Asian and European blocks. Now, more than ever before, it makes sense to see agriculture in the Americas as an interrelated whole; but this also introduces new problems and still-unmet challenges.

The region is becoming more “democratic,” at least in theory; but even so, governments are increasingly distant from their own people. As they provide more support and protection to international private interests for the sake of investment and economic modernization, all too often they neglect national concerns, the public interest and the needs of small capital and small producers. The natural resource capital is becoming depleted, human resources have lost value, and the resulting crisis of governance has sapped the willingness of citizens to trust their own governments and political parties.
**AGRICULTURE-RELATED ENVIRONMENTAL PROBLEMS IN LATIN AMERICA**

<table>
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<tr>
<th>Problem</th>
<th>Description</th>
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<tbody>
<tr>
<td>Agrochemical contamination (fertilizers and pesticides)</td>
<td>Agrochemical consumption in the region has increased over the past decade. In 1987, approximately 160,000 tons (active ingredients) of pesticides were used. In Central America, which uses more pesticides per capita than any other region in the world, 19,000 cases of pesticide poisoning were reported over a five-year period. A number of pesticides banned in the industrialized world (such as DDT and parathion) are still widely used in the region.</td>
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<td>Soil degradation</td>
<td>Two million square kilometers (10 percent of the region's land) were affected by erosion in the early 1980s, although the situation is much more severe in certain countries. An estimated 79 percent of Mexico's total land has problems with erosion, 28 percent is severely eroded, and 16 percent is stripped bare. Nearly 35 percent of Uruguay's land and 36 percent of the hilly pampas in Argentina were showing signs of erosion by the early 1980s. Regional studies in Peru, Chile, and Bolivia also measured erosion at levels between 30 and 80 percent of the total area studied. This soil erosion is the result of many factors, including the conversion of forest to pastureland, degradation of traditional hillside farming systems (for example, reducing fallow periods in clear-cut farming systems, or partial abandonment of certain cropping practices that are essential for soil conservation) and overgrazing in semiarid zones. Thirteen percent of the irrigated land in Mexico and 7.6 percent of all farmland in South America were found to have problems of salinization, due mainly to overpumping in irrigation districts, at the begging of the 1980s.</td>
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<td>Biodiversity loss and deforestation</td>
<td>Nearly 3.7 million ha of tropical forest (4.4 million ha of closed forest and 1.3 million ha of open forest) were lost every year of the 1980s; this was about half of all the tropical forest lost in the world during that time. Annual losses in Brazil alone totalled approximately 1.5 million ha of closed forest and 1.1 million ha of open forest; totals were 700,000 ha</td>
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of closed forests in Colombia, 670,000 in Mexico and 350,000 in Peru. Deforestation rates are particularly high (over three percent per year) in most of Central America, Ecuador and Paraguay, and over one percent per year in Mexico and Colombia.

Forest degradation can also be found in the temperate forests of Mexico and in the Andean countries. The main causes of forest loss include conversion to pastureland for extensive livestock production, land speculation, new population settlements, slash-and-burn farming, road construction, mining, and other development projects. Fuelwood shortages are an important factor in forest degradation in Haiti and El Salvador, and in specific zones in northeastern Brazil, the Andean Altiplano and the highlands of Mexico.

- Genetic erosion

Germplasm collections are urgently needed for over 20 crops plants whose genetic resources are under threat. These crops include: maize, beans, potatoes, yams, cassava, grapes, cacao, tomatoes, peppers, squashes and a number of forage legumes and grasses. Information available at present is insufficient to estimate accurately the status of genetic erosion in the region, although projects for collecting tomatoes and potatoes have encountered increasing difficulty in finding wild varieties.

- Contribution to global environmental problems

Greenhouse emissions were estimated in 670 Mton C/yr (1.6 ton C/cap/yr), or about 8% of the world’s total by 1985. Deforestation (52% of Latin America’s total), energy (28%), and agriculture (14%) dominate emissions. Stated emissions heavily depend on assumed deforestation rates. Revised estimates from deforestation in late 1980s range from 698 Mton C/yr (Myers, 1989) to 1500 Mton C/yr—mostly depending on assumed deforestation figures for Brazil—leading to an important modification of IPCC figures. Consumption of CFCs and related substances is about 2.5% of 5% of the world’s total. Contribution to ozone depletion is thus minimal. From 30,000 to 100,000 species may be lost by 2000 due to deforestation in tropical forests.

_After Altieri and Masera (1993)_
4.2 Misguided policies

In recent decades, macroeconomic and sectoral policies, both in Latin America and the Caribbean as well as the United States and Canada, have favored non-sustainable patterns of agricultural development. With few exceptions, they have encouraged processes whereby production and trade were concentrated in few hands, natural resources were subjected to overuse and deterioration, the environment was contaminated, specialization in production was pursued to excess, and the general capacity to visualize new development options for the medium and long term became too limited.

In the 1970s, trade and exchange-rate policies under the import substitution model in Latin America discriminated against agriculture. Food policies were designed to guarantee low prices for the basic food crops produced on peasant farms, thus keeping producer prices depressed. Such policies drove investment away from the agricultural sector. It became unprofitable to invest in measures designed to improve the condition of soils, forests and water, and the farmer’s standard of living suffered.

Subsidized credit and technology support were introduced to offset some of the discrimination against agriculture and encourage the use of machinery and agrochemicals, the expansion of extensive livestock production (especially in humid, low-lying tropical plains) and greater use of irrigation. Capital goods import incentives were introduced, along with public investment in infrastructure and special low rates on water and electricity for irrigation. Such policies harmed natural resources by promoting pesticide use and encouraging soil fertility management practices based on chemical fertilizers, conversion of forests to pastures, adoption of monoculture systems, heavy dependence on non-renewable energy resources and inefficient use of water for irrigation.

These selective incentives were also prejudicial to equity, as the sectors that generally had greater access to government subsidies were commercial agricultural operations and medium- and large-scale producers. Even though differentiated subsidized credit and technology support were always available to small producers, the levels of resources involved were never comparable to those offered to wealthier groups. In general, peasant farmers were hit hardest by policies that discriminated against agriculture, but this same group failed to receive the benefits of policies intended to buffer discrimination.

Land tenure policies usually defined forests as “idle land,” and encouraged projects for converting them to pastures or crop land. Many well-conceived agrarian reform initiatives failed because they were more concerned with converting reformed sectors into faithful supporters of the government in power than in helping rural sectors become economically viable.

The foreign debt crisis began in 1981, and the wave of structural adjustment and economic liberalization began to gather force. Many policies have changed as a result, but not always in ways that favor sustainable development. Discrimination against the agricultural sector diminished somewhat when the trend toward trade opening coincided with devaluation of national currencies, promoted by international banking institutions.
and governments of the North. However, this happened at a time when international prices for agricultural commodities were low, partly due to agricultural subsidies in the United States and Europe, outweighing any benefits the farmers might otherwise have received. Farmers who had been enjoying the benefits of protection policies for the agricultural sector found their shields slipping away. Even when average farmgate prices were higher, small-scale producers often failed to feel the difference. In the past four or five years, heavy flows of speculative capital have entered most countries, reversing the trend toward devaluation in many countries, but hurting the agricultural sector.

Recent policies have shown a marked bias in favor of production for export and against production for domestic consumption. On the average, this favors big producers and makes the economy more vulnerable. The export bias has been particularly associated with the production of "nontraditional" items such as fruits, vegetables, flowers and ornamental plants that depend on heavy applications of pesticides and serve highly fluctuating markets which are too risky for small-scale producers. "Traditional" export lines such as coffee or soybeans continue to be produced as well. A similar trend occurred in certain countries, such as Central America and Mexico, where extensive cattle ranching was encouraged in tropical areas and much of the production went for export of live animals and meat. Even the forest sector has now begun to experience the same trend, with the proliferation of vast plantations for wood pulp and other products.

Within the new policy framework, many of the subsidies for agriculture, both overt and indirect, have been eliminated. Less farm credit is now available, and interest rates are higher. Budget cutbacks have affected public expenditures on medium- and long-term investments such as research, extension, infrastructure projects, and higher education. These are the very activities, funded by public allocations, that traditionally encouraged unsustainable patterns of development, when in principle, budget cuts could have favored the introduction of more appropriate technological patterns. However, the mere elimination of adverse incentives has not been enough to bring about the desired effect. More decisive steps also need to be taken in favor of sustainable development, such as investing in the rehabilitation of natural capital. Moreover, the same strong bias so common in the past has again been evident, as subsidies for small-scale production and domestic consumption are eliminated in support for large-scale producers and agricultural exports. The net result of all these recent changes has been less than encouraging for the majority of small-scale producers, the rural poor and for the environment.

The United States and Canada have opted for a very different policy approach to the agricultural sector, but in some ways, the results have been similar. These countries have heavily subsidized the price of agricultural goods, and in some cases, farmers have been paid not to produce. Agriculture has not been the victim of discrimination. However, the subsidy system has fostered the use of large quantities of agrochemicals, the waste of water, mono-crop farming, and the conversion of certain fragile areas for agricultural use. Farmers seeking subsidies must abide by a vast array of rules and regulations that often interfere with the adoption of more appropriate land uses and production practices. The present system also heavily favors large-scale producers and agri-businesses, contributing to the concentration of the agricultural sector in an ever-smaller number of hands.
Several efforts have come to the fore in the United States in recent years to cut back on production subsidies and to eliminate incentives that encourage land use and production practices likely to contaminate or degrade natural resources. Attention has focused on strengthening rules and regulations that govern the use of pesticides and other types of contamination generated by the agricultural sector. However, little has been done to defend the interests of small farmers. Environmental problems remain largely unsolved. At the same time, public investments in research, extension and support for rural infrastructure are under heavy pressure, despite their potential to make development more sustainable. Private investment on biotechnology threatens to change the nature of agricultural production as we know it today.

4.3 Obsolete institutional frameworks

Government participation in the agricultural sector has been sharply cut in Latin America and the Caribbean in recent years. Gone are most of the public agencies that engaged in marketing basic foodstuffs, along with state-owned production operations. Even government institutes for agricultural research and extension, agrarian reform, credit and irrigation have lost budgets and influence, and many are under pressure to become economically self-sufficient.

In any case, these entities were not designed to bring about sustainable agricultural development. The overriding objectives of their programs, organizational structures, working methods and staff endowments was to boost agricultural production over the short term, lower consumer food prices, and solidify a system of rural political patronage in favor of ruling governments. The purpose was never to bring about a more democratic economy or harmonious relationships between human society and nature. The bias was always uncompromisingly vertical, meaning that the state handed down its policies with little participation from the sectors involved, especially in the case of peasant farmers, indigenous peoples, women, and marginalized zones.

The entire government structure suffered from severe problems of internal coordination among the different agencies, and inconsistent policies. At present, much agricultural research and many development institutions and extension services have little or no real connection with the rural population; and it is nearly impossible to have a positive impact on communities if farmers are not involved in determining the content of research, technology development and transfer. All too often, national and international agricultural research institutions are out of step with extension agencies; all three often work at cross-purposes with universities, technology institutes and other educational institutions with a rural focus. Finally, a wide gap often separates agricultural sector institutions from environmental or natural resources agencies.

Attempts are now being made to reverse this situation. A first step has been to create new cabinet ministries, bureaus and projects for natural resources and the environment. Generous funds of public moneys have also been set up to finance social services and small rural infrastructure projects. International centers and national institutes for agricultural research have expanded their agendas in the field of natural resources, and new areas have
been opened for deliberation, consensus building, dialogue, partnerships and joint action by the public sector, institutions of civil society and private enterprise. However, it is still too soon to tell whether such initiatives will have the desired impact.

So the public sector has weakened, leaving a vacuum that private companies and institutions of broader society can fill only partially. If agriculture is to develop sustainably, the existing institutional framework will need to be replaced with a new one that is better equipped to meet the goals envisioned for it.

Private companies sustain only a very limited commitment to reducing poverty or taking better care of natural resources. Their final goal is to maximize profit, which they often define as short-term profit. Agricultural supply and biotechnology companies are interested primarily in selling as many inputs as they can. In certain cases, the drive for higher profitability in these companies can actually yield beneficial results, as for instance when they generate many highpaying jobs or focus their efforts on the so-called “green markets.” In and of itself, though, this will not bring about sustainable development.

The prospects of having a meaningful impact are much brighter for the institutions of civil society (farmer communities and associations, nongovernmental development organizations, churches, universities and environmental groups) and local governments. Recent years have seen an explosion of literally thousands of local, regional, national and international nongovernmental groups whose focus is specifically on sustainable development of agriculture and natural resources. In many cases, they tend to be more in touch with the needs of the grassroots. They have more advanced ideas about the potential for alternative technologies, they are able to mobilize certain resources at local levels, and they are free of the worst bureaucratic inefficiencies. At the same time, however, many are very weak technically and administratively; they do not always practice the democracy they preach; and they are heavily dependent on external resources, which gives them a very fragile outlook for institutional development.

The same pattern can be traced in the United States and Canada, although to a lesser degree. There, too, the public sector has been weakened and downsized; but the process has been more gradual, and government intervention continues to be decisive in many areas of the agricultural sector. Individuals involved in agriculture and forestry have many more opportunities to participate in policy decisions, although small-scale farmers have continued to exert little real influence. Given the stronger legal and regulatory framework, private companies have had greater incentive to practice socially and environmentally acceptable forms of behavior. This is beginning to change, however, in view of the current trend to lift legal restrictions on private activities. For the most part, the institutions of civil society are more technically and administratively competent and financially independent than in Latin America and the Caribbean, but they are up against much more consolidated interests that favor nonsustainable patterns of development.

4.4 Destructive technologies and increasing vulnerability

The development models that prevailed in the Americas in recent years have left such a deep imprint on agricultural technology patterns that the transition to sustainable agri-
culture has become very difficult. Most of the agricultural know-how acquired over the past few decades accumulated under the umbrella of policies, prices and values designed to encourage undiversified, capital-intensive agricultural practices poorly suited to specific local environmental conditions. This kind of production generally offers abundant physical yields (at least for a while, and mostly from the principal crop), but not necessarily lower production costs (especially when environmental costs are factored in), and frequently at much greater risk to producer and consumer. For many years, relatively little effort was expended on improving and making better use of the in-depth technical knowledge already held by indigenous populations, peasant farmers and even some medium- and large-scale producers, or in building a serious dialogue between supporters of the so-called “modern” agriculture and proponents of “alternative” types of agriculture. As a result, agriculture has fallen so far behind that even if policies and institutional frameworks were to undergo an immediate turnaround in favor of sustainable agricultural development, a lengthy transition would still be required for technology innovation, adaptation and exchange to take place. Only then could the new agricultural development models begin to bear full fruit.

Concrete experiences already on record demonstrate the feasibility of producing enough food to meet rising demands for agricultural products in the societies of the Americas, while simultaneously reducing environmental impacts through lower use of agrochemicals and scarcely increasing the amount of land under cultivation. A move towards settling up such efforts would require initiative to identify, generate and promote new, more appropriate technologies; but so far, such efforts are limited.

The region has lagged behind, not only in developing technology to make agriculture sustainable, but also, and perhaps above all, in terms of trained people working in this sector. Universities, technical schools and programs for professional advancement continue to demonstrate a marked bias in favor of the same technological patterns that were promoted in the 1970s. These patterns rarely focused on the environmental and socioeconomic issues surrounding production, nor did they make use of knowledge available from farmers. They favored a mechanical and atomistic approach instead of challenging technical people and professionals to use their analytical skills to focus on the broader issues. Latin America and the Caribbean were far too slow in tapping the potential of computers, geographic information systems, simulation models and the proper use of bio-technology, although there are now incipient processes to reverse this trend.

4.5 Low levels of social participation

Why have misguided policies and obsolete institutional frameworks prevailed for so long? Many critical decisions continue to be based on the interests of small elites, and many groups that have much to contribute to the discussion are overlooked and not consulted. Latin America has taken giant steps in its transition from authoritarian regimes to elected governments and granting greater power to local institutions; but throughout the Americas, resistance prevails to give a more active role to local communities, small-scale farmers, indigenous people, consumers and women in making the decisions that
affect their daily lives. This is partly due to the fact that powerful economic groups and technocrats have monopolized all access to government and frequently derive substantial benefit from policies that are not conducive to sustainable development. It is also largely due to the fact that key decisions are increasingly made outside the governmental arena, by transnational companies and international banking institutions. These bodies are the product of no democratic election, and generally do their utmost to restrict access to information. The political and institutional conditions necessary for sustainable development will prove very difficult to achieve unless governments become more accountable, new mechanisms are created for building consensus and dialogue with the groups that have traditionally been shunted aside, the social role of private companies and international banking institutions is clearly defined, and decision-making becomes more transparent.

Supporters of the different schools of thought have become utterly polarized concerning economic and social policies, technology patterns in agriculture and the role of the state and civil society. This in itself has frequently prevented them from engaging in any kind of constructive dialogue. Polarization, instead of catalyzing social change, actually obstructs it, eventually closing the very doors that could eventually lead to new, innovative responses.

4.6 Shortsighted responses to swift change

As was stated in the first section of this booklet, the fundamental requirement of any sustainable social system is its ability to adapt to changes in the environment and improve the odds of reaching its objectives over time. The political, economic, social, cultural and technological changes affecting agriculture in the Americas are unfolding at dizzying speed. In such a setting, it is particularly alarming to see our societies unable to recognize and understand these changes, adapt to them and even encourage new options to meet the new objectives set by such changes.

More worrisome still is the fact that many of the traditional milieux for reflecting on the future, such as universities and other academic entities, have been weakened, and no alternative forums have arisen to take their place. Certain attempts, still in their infancy, have been made to open a dialogue with broad sectors of society over trends that can be expected in the future, and even the type of future we want to build.

Governments, private companies, and even many institutions of civil society stubbornly persist in taking a short-term view. Thus they often prefer to ignore needs and possibilities of the future, a blindness which in turn lends itself to greater degradation of natural resources, discourages investment in human resources, and has a direct impact on medium-term productivity in the economy. It reveals an unfortunate lack of vision in time and space.
5. GUIDELINES FOR THE FUTURE

As we saw in Section 2, sustainable development for agriculture and natural resources implies:
- Drastically reducing poverty, doing away with hunger, and discouraging consumerism and waste.
- Mobilizing civil society so that all members of the agricultural sector participate fully in making the decisions that affect them (empowerment).
- Safeguarding the natural resources and environmental services essential for meeting the needs of producers and consumers in the future.
- Implementing institutional and production systems that are flexible and adaptable enough to take on new challenges.
- Having a solid foundation of diversified, robust and resilient production systems.
- Making systems more self-reliant, without going to the extreme of total self-sufficiency (autarky).

5.1 Policies for sustainability

One of the areas needing the most far-reaching innovations is clearly the legal framework and land ownership rights, including constitutional reforms that specifically address issues of environment and natural resources. The rights of future generations must stand as political constraints on the economic behavior of today's generations, and as such, need to be expressed in constitutional law. Current natural-resource laws therefore need to be modernized and brought into line with the principles set forth in the Earth Charter, Agenda 21, the Biodiversity Convention, and the Forestry Principles undertaken at the Earth Summit in Rio de Janeiro.

In some cases, natural resources and environmental services continue to qualify as publicly-held assets, fully or partially. In such cases, governments need to establish or enforce clear ownership rights. For example, all countries need a legal framework to regulate ownership of biodiversity and genetic resources. This will foster biodiversity conservation both in the wild and in cultivation, pave the way for research in genetic improvement, and reward those who have endeavored to conserve this genetic wealth. Peasant and indigenous groups also need their land ownership rights legally recognized, as they tend to protect their forests and other natural resources much better than the state protects national land. It is worthwhile in this context to draw attention to Mexico's recent decision to take a step backward, amending agrarian reform laws that were unquestionably the most progressive in the region.

The government and society as a whole need legal and administrative tools to respond effectively whenever anyone contaminates or degrades resources that are or should be part of the public wealth, such as the atmosphere, certain sources of water and protected species and areas. On behalf of society, the enforcing entity should
charge the offender for the cost of damage in the form of fines, fees or taxes, or prohibit such activities altogether. In cases where the government lacks the supervisory and monitoring capacity or authority to safeguard public interests, certain rights and responsibilities associated with those resources can be delegated to private entities. Likewise, private entities whose interests are jeopardized by contamination from pesticides, sedimentation, agroindustrial waste and the like, need to have expeditious legal mechanisms available to demand compensation for any loss or damage they have incurred.

It is equally important to strike a proper balance between invoking regulations, fines and taxes, and holding out incentives, technical assistance and other benefits. It is not enough simply to restrict certain practices or land uses; a proactive stance is the best way to promote new, more sustainable forms of production.

As an example, certain producers are willing to implement agricultural production systems that contaminate less and pose fewer health hazards. They should be provided with incentives to convert to low input systems and be compensated for the environmental services they are providing. Similarly, countries, communities and individuals that own forests should be paid for services provided by their woodlands, including sequestering carbon, regulating water flows, and sheltering wild flora and fauna. This is why there is such a need for concrete, transparent mechanisms, such as government subsidies or private transfers within a governmental regulatory framework. Even market mechanisms could be useful. Certification programs could offer a "green seal" for organic produce, lumber taken from sustainably managed forests, and other goods produced under conditions that society wishes to reward (such as shaded coffee systems). The use of "green labels" should be promoted for domestic and export markets alike, and be undergirded by legislation enacted specifically for this purpose.

Whenever a policy is designed to reward the sustainable development of agriculture, its environmental and social impact need to be examined. High exchange rates, low interest rates and low import tariff on manufactured goods tend to spark greater activity in the agricultural and forestry sector. Depending on the particulars of each case, the final outcome could be either positive or negative. Policy measures may boost production of certain goods specifically suited to the conditions available, attracting long-term investment in such activities as soil conservation. Other policies could favor inappropriate land uses by pushing cultivation into marginal zones or triggering overuse of inputs.

It is particularly important to reexamine the new trade liberalization policies to assess their social and environmental impact. It is time to start seeing trade as the means to achieve certain social ends, and not as an end in itself.

National accounts are an essential tool for policy planning and decision-making. It is very important for them to include: net worth figures that attach accounting value to natural resources and environmental services; accounts that measure investment flows into and away from these resources and services; and human development indices and
social accounting tables that reveal degrees of equity. This would give a clearer picture of the degree to which current development patterns are actually sustainable.

Analytical studies of this kind may provide the rationale for eliminating a whole series of misguided policies that lead to environmental destruction and social injustice. For instance, they would reveal the need to do away with subsidies under which big consumers of water and energy are rewarded for using these resources inefficiently. This would mark the end of tax and financial incentives for deforestation and heavy use of pesticides, and of labor laws that foster the creation of temporary employment offering no benefits or job stability.

There is also a need for policies that differentiate among various types of producers. Large-scale farmers are unquestionably important today, and will continue to be so in the future; however, family farms, peasant and indigenous producers should be specifically targeted by policies that guarantee equity and recognize the compatibility of the agroecological rationale that these producers hold and the objectives of a more sustainable agriculture. Policies for farm laborers should promote stable, reasonably well-paid employment, and labor laws need to be improved in such areas as trade-union rights, job stability, minimum wage, occupational health and housing. Such policies should also provide concrete enforcement mechanisms.

Land tenure policies should seek a truly equitable agrarian structure and attract long-term investment in activities such as conserving and rebuilding soil, and practicing productive forestry. Certain countries still need to undertake agrarian reform programs, specifically targeting the needs of women, and land-lease laws should encourage long-term investment and guarantee that tenants have a stake in any improvements made to the property. Programs are needed for awarding land titles without stunting speculation, and agrarian reform laws must stop classifying forested areas as idle land.

Policies for public financing need to castigate activities that contaminate and degrade natural resources, and credit awards should be tied to the use of appropriate production practices. Another pressing need is to develop policies under which financial markets will provide effective brokerage between investors with different time horizons on their investments, so that resources are channeled toward the forestry sector, technological innovation, and other medium- and long-term activities. Investment funds could also be created for rehabilitation of natural resources, funded with a tax on extractive activities or their consequences, such as deforestation, erosion, overgrazing and the extraction of nutrients that are not replaced.

It is time to take a new look at local experiences involving financing mechanisms, technological improvements, marketing schemes, community infrastructure, social organization and other topics. Such experiences can be useful in formulating broad policies, whether for promoting replication of similar experiences in other places, or simply opening up new opportunities for local organizations to develop their own alternatives.

The most effective government investments for promoting sustainable development are probably in science and technology and in formal and nonformal education. Those are the activities that can ultimately improve the efficiency of resource use, reveal new substitutes for nonrenewable natural resources, and develop new techniques for rehabilitating degraded natural resources. There is an urgent need for agricultural universi-
ties to change their curricula in order to train professionals capable of confronting the future challenges facing agriculture.

For a number of reasons, the private sector cannot be expected to invest enough in these fields. Much of the necessary technology is reckoned as a public good. Research is risky. The benefits of human resource training do not necessarily devolve on companies making the investment, because of high rates of labor mobility. Finally, private enterprises tend to work within a relatively short time horizon. It thus falls on the public sector to make the effort, always in close coordination with private entities.

Any government wishing to make sustainable improvements in income distribution and international market competitiveness has a powerful tool at its disposal: human resources training. In the new global economy, it is increasingly difficult to rely on protectionist policies and other forms of government intervention to prop up agricultural wages or preserve high prices for agricultural goods. However, a well-educated population with current knowledge about the new international environment can help make the economy highly responsive, so long as national policies avoid interfering with attempts to make more efficient use of human resources. Public universities and advanced technical training institutes deserve much more support than they now receive and have great potential as centers for incubating new ideas, training, research and development.

The amount of money invested in education is not the only problem, though; equally critical is the quality of education. School systems in most countries have lagged far behind at every level. It is time to take a new look at these systems, and reform them according to the principles of sustainable development in agriculture and natural resources.

More than ever before, today's world requires a forward-looking effort to identify threats and opportunities that may arise over the medium and long term, model scenarios and define strategies for responding to different contingencies. We face great uncertainty about future threats to the environment, and we do not know how quickly technological change will unfold in the coming years. This is why we need cautious policies designed to prevent catastrophic problems.

5.2 Toward a new institutional framework

Much has been said about which institutional framework might be the most appropriate for sustainable development. These discussions tend to revolve around the issue of whether the process should be led by the state, by private companies or by broader society. Such comparisons are unrealistic and unhelpful because sustainable development requires combined efforts by all the forces in society.

Certain tasks must always remain in government hands: setting the legal framework, defining property ownership structures, setting macroeconomic policy, creating tax systems and control mechanisms, transferring resources among different groups, and investing in activities for social benefit when private companies are unwilling to do so. Likewise, the state continues to provide a key setting for dialogue, where society can debate about the type of future it wishes to build.
The government cannot perform these functions effectively unless all groups involved in agriculture and forestry play an active role in decision-making, and greater emphasis is placed on cooperation between the state and society as a whole. Elites have always participated in decision-making within the realm of the government; but now it is time to build new democratic mechanisms for opening a serious-minded dialogue with the sectors that have always been sidelined, including indigenous peoples, small-scale and peasant farmers, women, farm laborers, community and environmental organizations, local governments, religious groups and nongovernmental development organizations. Unless all sectors of the population become more aware and participate more broadly, it will never be possible to forge the sectorial alliances that are so necessary if a sustainable development strategy is to be politically viable. Indeed, there is no exclusive sustainable development strategy, and this is why it is so important for the different sectors to define what type of partnership and strategy they want, through democratic processes and consensus-building.

The building of a consensus on sustainable development requires a serious effort to overcome long-standing polarizations. Those who have striven primarily to increase overall production are far removed from those who have emphasized environmental and social concerns. There is also a need for frank dialogue among the different sectors of society, cultural groups, nationalities, sexes and schools of thought, as a building block for a new sustainable development partnership in this hemisphere. Valuable contributions can be made both by the form of agriculture known as "conventional," and by the approach that has been dubbed "alternative," "ecological" or "sustainable." The cold war is over, and most of the authoritarian regimes have vanished; this opens important new possibilities which must not be wasted. Admittedly, many of the divisions and differences besetting us today have deep roots and a long history; conflicts are bound to arise among different groups. But we need to resist the idea that differences are too entrenched to permit a useful dialogue concerning the prospects for new forms of development.

Many promising initiatives have already been taken to engender the participation of civil society in setting policies and priorities and in carrying out joint activities that bring together the government, private enterprise, and society at large. Most of the countries in the Americas have created National Sustainable Development Councils where different sectors of society have a say. Representatives of civil society sit on the boards of directors of many government projects, which in some cases have begun to finance the activities of private entities. Even national institutions for research and technology transfer are increasingly interested in creating participatory procedures and working methods. New mechanisms are emerging for financing, training, service delivery and information exchange, which bring the government into partnership with nongovernmental sectors. Such efforts need to be strengthened and broadened if they are to be translated into true progress toward sustainable development of agriculture.

Many national governments have undertaken processes of decentralization, placing more power in local hands. In general, this improves the likelihood of public participation in formulating sustainable development strategies. The availability of natural resources varies drastically from one place to another, as does the management of these resources. It is impossible, at a centralized level, to be familiar with all this diversity and
respond to it appropriately. This is why decentralization holds out great promise for adapting policies to real-life social conditions and for eliciting participation in formulating sustainable development strategies. The micro-regional approach can be an extremely useful tool for land management and local development. However, for responding to problems of water, sedimentation, generation of hydropower, and protection of coastal zones, a watershed-level or micro-watershed-level approach is desirable.

Within this framework, commercial private interests can play an important, positive role, so long as it is clearly understood that the market has only a limited ability to bring about some acceptable degree of equity or to take a long-term view. Transnational companies and national chambers of commerce have become a critical factor in defining many of the variables that will determine whether sustainable agricultural development can be achieved, and this is unlikely to change in the foreseeable future. This is why it is essential to hold a serious, broad-based dialogue through which these sectors will take on specific commitments for a new pattern of development.

It is also necessary to take a new look at the role of universities, training institutes and research centers. The world of academia must take the lead in a thoughtful analysis of the needs of agriculture in the future, and how best to train professionals who will be able to respond to such needs. Those and other entities must train decision-makers in the government and in nongovernmental organizations, so they understand the implications of the studies being conducted and act accordingly.

Ultimately, it is the organizations of civil society that must play the most active role in putting forth concrete proposals for the sustainable development of agriculture, and in carrying out pilot activities that will set an example for society as a whole. Farmer associations, peasant organizations, development NGOs, indigenous movements, churches and environmental groups have often been the first to express the need for a new agroecological approach or a focus on sustainable agriculture. They were the first to articulate the link between issues of social justice and environmental concerns, and the pressing need to introduce new methods for expanding opportunities to participate. It would be an error to romanticize the role of these groups, or to ignore the many limitations they still have; but they need to be supported, strengthened, and incorporated into processes of governmental decision-making, and the lessons and experiences they bring to the table need to be fully tapped.

5.3 The technological revolution and agroecology

Today's world is undergoing a technological revolution at least as far-reaching as the industrial revolution, and an agricultural revolution perhaps greater than anything seen in several thousand years. The fields of microelectronics, computers, systems analysis, molecular biology and materials have been opening new frontiers whose impact on agriculture and natural resources in the Americas will be too vast to be ignored or underestimated. While these great strides open a myriad of possibilities for human progress, there is no certainty as to how they will be used. This will depend on the ability of the different sectors of society to guide technological development, put it to good use and modify it.
which in turn will depend largely on improvements in the educational system, greater investment in science and technology as a non-profit endeavor and the consolidation of democratic mechanisms.

Although it seems contradictory, the technological revolution has also opened the way for a new appreciation of traditional agriculture and the native wisdom of indigenous people, peasant farmers and small-scale family farmers. When cutting-edge technology is merged with indigenous lore, many of the capital goods used in agricultural production can be replaced with know-how and genetic resources, and certain hazardous or contaminating inputs can be replaced by other low-input methods that are much more innocuous. The idea is to develop agroecosystems that are minimally dependent on heavy doses of agrochemical inputs and energy, and that emphasize interactions and synergies among the various biological components of production, making the agroecosystem ecologically and economically more efficient while improving environmental protection.

Expanding, sustainable food production needs to be integrated with the sustainable management of natural resources. Only if the two work in concert will it be possible to meet the needs of present and future generations, while still preserving and even improving the quality of the environment. Newly emerging technologies and new scientific developments offer power, flexibility and knowledge that need to be combined whenever appropriate with traditional technologies. Thus, the notion of agriculture will eventually become synonymous with sustainable, productive development of natural resources, including soil, water, and plant and animal varieties, and even biodiversity (in its twofold role as economic resource and ecological regulator), as well as with the maintenance of environmental functions and services such as watershed protection, climate regulation, nutrient cycles, and the like.

The new technological approach being applied to the development of sustainable agriculture revolves around the basic science of agroecology. Agroecology is much more than the traditional one-dimensional view of agroecosystems that emphasizes only genetics, soil science or agronomy. Instead, it embraces a full understanding of the ecological and social levels of coevolution, structure and function. It departs from the traditional approach of defining constraints and key limiting factors. Agroecology motivates researchers to capitalize on the knowledge and skills of farmers. It leads them to identify the unlimited potential created when biodiversity is enhanced so that the beneficial interactions and synergies among the biological components equip agroecosystems with the ability to maintain an innate state of natural stability.

An agroecosystem can become more sustainable if the agroecological management program succeeds in optimizing the following processes:

1. Flow of nutrients: The productivity of an agroecosystem is directly proportional to magnitude of the nutrient flow: availability, balance, mobilization and conservation. It requires a steady supply of organic matter, along with practices that catalyze biological activity in the soil.

2. Protection and conservation of the soil surface: An effective means of conserving soil and water is to minimize erosion by managing plant cover through the use of cover crops,
mulch (a layer of manure and straw to protect plants), and zero tillage. Continuous live plant cover or cover with crop residues from properly managed systems is crucial to maintain production potential.

3. Efficient use of water, sunlight and soil resources: It is crucial to keep at a minimum losses due to air and water flows. Their impact on soil loss can be minimized through proper management of microclimates and moisture and erosion control.

4. High levels of total and residual biomass: The purpose of maintaining biomass is to sustain soil biology and animal and plant productivity. Because it is very rich in carbon, biomass supplies energy and facilitates nutrient retention. It can be maintained by adding organic matter in the form of legumes, keeping animals in the field, and harvesting in such a way as to remove only a small portion of nutrients from the total biomass.

5. Tapping the full potential of animal and plant genetic resources, both native and exotic.

6. Taking advantage of available knowledge on life cycles, behavior and interactions between insects, microorganisms and weeds.

7. Conserving and integrating biodiversity: The system's ability to recycle nutrients efficiently and remain stable in the face of pest and disease attack depends on how much biodiversity is present, what type it is, how it is organized in space and time (structural diversity); and particularly, its interactions and synergies (functional diversity).

Each type of agricultural situation will have its own unique way of internalizing these principles, depending on environmental and market conditions and the type of producer involved. Technological pluralism is both inevitable and desirable. It means that different producers find very different ways to manage their production systems, even if they are in the same place. Nevertheless, certain fundamentals are valid for nearly any situation: the basic principles for getting the most out of all possible sources of technology, synergies in the agroecosystem, and the enormous potential of native and improved genetic resources.

5.4 Strengthening the seeds of hope

The main challenge facing our continent is to design and implement effective management systems that bring three issues into balance: economic growth, social equity and environmental sustainability. Given the myriad interpretations of the concept of sustainable development, a first pressing task is to begin building consensus among the different sectors of society on how to implement it in accordance with real local conditions. In the end, concepts are tested and implemented locally. However, the process of decentralization needs to be balanced, so that local concerns interlink with national, regional and global conditions. This will prevent the state from being exposed to progressive weakening and from losing its shared national vision.

This type of management cannot succeed unless capital, information and education become more democratic, and participatory mechanisms for decision-making are strengthened and achieve greater legitimacy. It calls for nothing less than a new social
can sketch out their own visions of nationhood and community.

The process begins at the grassroots and is built on a number of premises. First, the household is the basic unit of production. Second, people belonging to these households organize into community, cooperative or associative enterprises which operate in accordance with the specific ecological and social conditions of the places they work. This means that the principle of centralized control must give way to local governing systems based on community awareness or collective consciousness of real geographic, ecological and cultural conditions.

After the Rio de Janeiro meeting, it became clear that the economic, social and ecological paradigm shift will not begin at the global level. Micro-regions, communities and human groups will be the first to transform the social and economic fabric to make sustainability and social equity a reality. Patterns of consumption and production need to recreate the virtues of traditional knowledge, combined with modern technologies, and they must take full advantage of the possibilities for trading inputs and products at local and regional levels.

The seeds for the future of this continent can be found in the people's real possibilities for building such a utopia. This calls for a new concept of local sovereignty in which ownership of natural, cultural and social wealth remains in the hands of communities. It is not a question of rejecting outside influence, but rather of incorporating it by first grounding it locally so that the benefits of the modern world and global priorities are fit into the context of local realities and the aspirations and values of each community.

A look at agriculture in the Americas today evokes more concern than optimism. Problems of poverty, environmental degradation, political elitism and the short-term technological mentality have deep structural roots that will not be easy to change.

Nevertheless, the seeds of hope (or as some would put it, the seeds of resistance) are also present. They can be found in:

- Indigenous movements throughout the Americas, which are demanding rights to their lands and holding on to the hope of protecting their lives, cultures and nature.
- Peasant and small farmer organizations that are demanding new recognition for their right to land and their role in preserving the environment.
- The thousands of development NGOs that are promoting agroecological methods.
- Technological developments in integrated pest management, agroforestry, soil management, genetic resources and recycling of agroindustrial waste.
- New academic and research programs at many universities, technical institutes and research centers, which emphasize sustainable agriculture and thus that are much better suited to the real needs of the entire primary or rural sector.
- New policies to expand forest cover, preserve biodiversity and reduce the use of toxic pesticides.
- The new "green" markets and the willingness of consumers to demand wholesome products raised under healthy conditions.
- The emergence of many new opportunities for exchange, discussion and reflection.

In all these processes, the micro and the macro, the local and the global are closely interwoven. Some groups are working at the level of individual farm plots or single com-
munities, while others have focused their concern on regional planning and the broad trends of trade liberalization or structural adjustment policies. Activists are advocating sustainable agricultural development in the government, in private companies, in broader society, in universities and research centers, in international organizations and in local governments. It is becoming increasingly evident that the work at all these levels dovetails perfectly, and none can replace any of the others. It would be erroneous to claim that any such effort could match up to the full dimensions of the problems; taken together, however, interlinked and flowing into a single rushing torrent, they entail the seeds of hope.

Indeed, we have come far. But much remains to be done!
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