

## How to Teach Agroecology: A Proposal

■ The unexpected impacts of economic development, especially in its environmental dimension, have generated a major crisis of the agricultural productive model questioning the long-term sustainability of existing food production systems. Evidence has accumulated showing that whereas the present capital- and technology-intensive farming systems may be productive and competitive in the short term, they bring a variety of long-term economic, environmental and social problems. From an ecological perspective, the regional consequences of monoculture specialization are multiple including the high use of agrochemicals (pesticides and fertilizers) as well as transgenic crops, which have been linked to an array of environmental problems; the worsening of pest problems; soil erosion and loss of local crop varieties. Moreover the efficiency of use of applied inputs is decreasing and crop yields in most key crops are leveling off because of the steady degradation of the natural resource base of agriculture brought about by unsustainable practices.



Agricultural policies favoring the globalization of world markets, allowing rich countries to dump their overproduction at prices that are disincentives to local producers, and the control that multinational corporations exert over seed supplies and the food system in general, are leading towards a progressive loss of economic viability for small farmers, threatening in turn traditional forms of agriculture and their associated knowledge systems and agrobiodiversity, as well as the food security of many regions. Of special concern are microcosms of agricultural heritage, found throughout the world, and covering about five million hectares, which still provide a series of cultural and ecological services to humankind such as the preservation of traditional forms of farming knowledge, local crop and animal varieties and indigenous forms of socio-cultural organization. If these systems continue shrinking, victims of modernization and other technological and economic changes, once they have disappeared their unique agricultural legacy and associated environmental, cultural and nutritional benefits, both local and global, will be lost forever.

World agricultures appear to be approaching a crossroads. Will the countries continue to divest themselves of the agricultural sector as cheaper suppliers emerge elsewhere and as land, water and human resources are redirected to industrial or mining activities promising greater economic returns? Will globalization push farmers off the land and turn remaining farmers into farm workers? Will farmers join others in a massive effort to demand land reform and food sovereignty? Will prime agricultural land succumb to negotiations as population growth and decentralization forces reallocate farms to development? Will society allow agriculture to externalize costs such as water contamination? Or will regional cities recognize that their environmental quality and people's health depend on the integrity of the surrounding countryside for water, food and nature? Will consumers reshape agriculture by favoring goods produced with local agrobiodiversity and following agroecological practices? What types of agriculture will exhibit resiliency given predicted climate change scenarios? These are important questions, and correctly addressing them is essential for humankind's survival via a durable agriculture.

It is obvious that a new path of agricultural development is needed and that the role of rural societies must be redefined using new criteria which view agriculture as not only having an economic and food-producing role, but that also emphasizes its environmental, cultural and social roles, key for the long-term sustainability of both rural and urban environments. High-input monocultures that dominate the landscapes of industrialized countries and of the agroexport sectors of the developing world are ecologically vulnerable and need to be converted to systems that are more biodiverse, require less use of external inputs and are able to produce high-quality food without degrading the environment. In the peasant sectors of the Third World the challenge is to assist, through participatory modes, resource-poor farmers in translating agroecological principles into a variety of strategies to restore the ecological integrity of their small farming systems. This will require redirecting research to be more problem-solving and more participatory so that it is relevant to the needs of the rural poor. Understanding the ecological mechanisms underlying the sustainability of traditional farming systems and then translating them into principles that take various locally available and appropriate technological forms applicable to a massive number of farmers will be a key task.

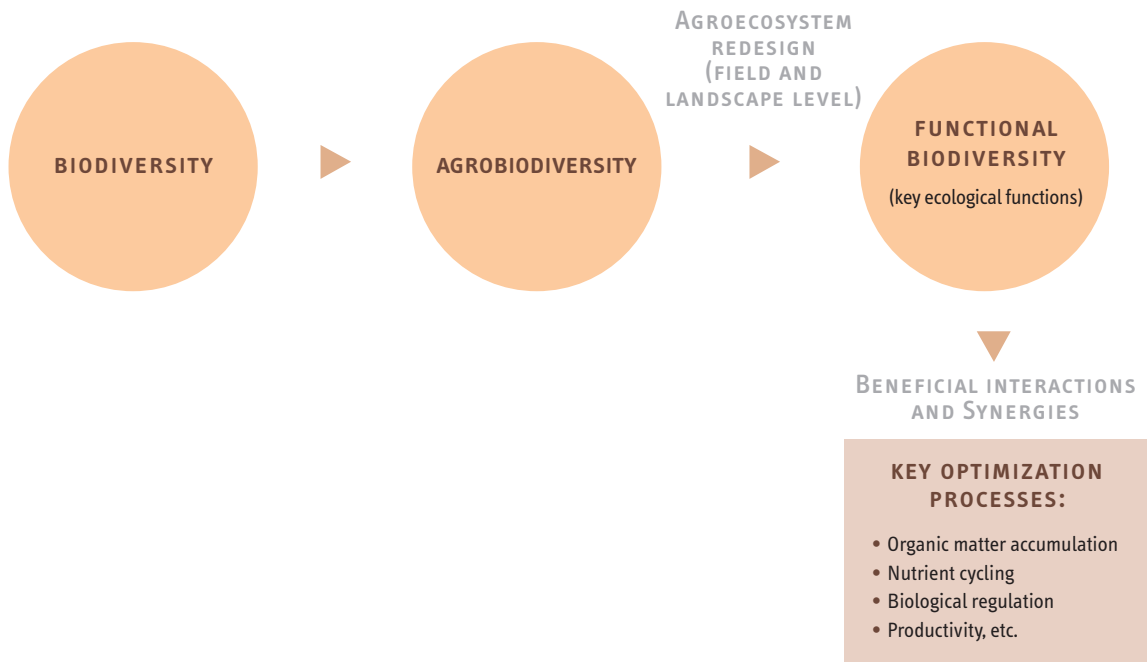


#### WHAT IS AGROECOLOGY?

The science of agroecology, which is defined as the application of ecological concepts and principles to the design and management of sustainable agroecosystems, provides a methodological framework to tackle this task. The central idea of agroecology is to develop agroecosystems with minimal dependence on external inputs, emphasizing complex agricultural systems in which ecological interactions and synergisms between biological components provide the mechanisms for the systems to sponsor their own soil fertility, productivity and crop protection. By assembling a functional level of biodiversity (i.e. a collection of interacting beneficial organisms that play key functions within the farm) it is possible to initiate synergisms which subsidize farm processes by providing ecological services such as the activation of soil biology, the recycling of nutrients, the

enhancement of beneficial arthropods and antagonists and so on, all important in determining the sustainability of agroecosystems (**Figure 1**).

**Figure 1.** *Agroecology provides guidelines to design agroecosystems rich in functional biodiversity which through interactions and synergies promote ecological processes crucial for a durable agriculture.*

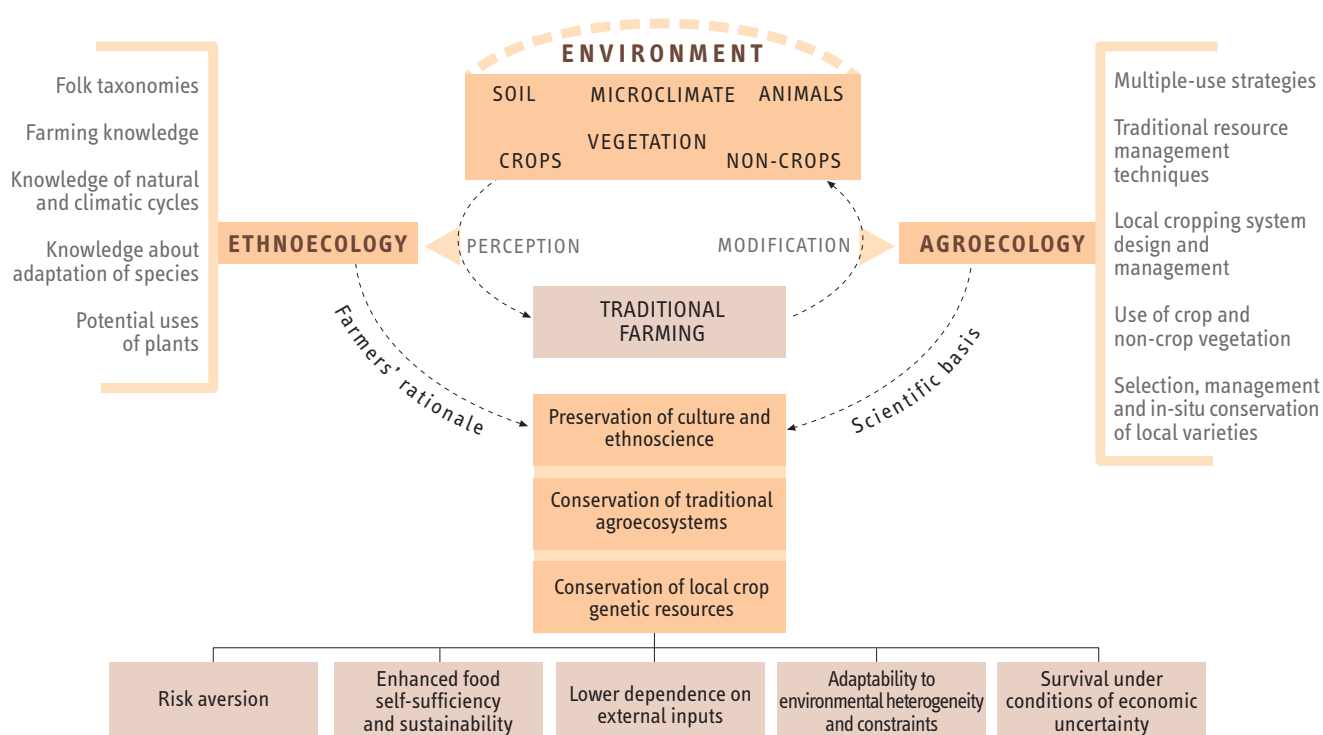


The exploitation of these interactions in real situations involves innovative farm designs and management which require an understanding of the numerous relationships between soils, microorganisms, plants, insect herbivores and natural enemies. Breakthroughs in sustainable production have already been achieved in many countries using agroecological approaches that emphasize diversity, synergy, recycling and integration, as well as social processes that value community involvement and empowerment.

Throughout the developing world there are still microcosms of intact traditional agriculture representing thousand-year-old examples of successful forms of community-based local agriculture and which offer promising models for other areas as they promote biodiversity, thrive without agrochemicals, and sustain year-round yields. Recognizing this, agroecology serves as bridge to promote a dialogue of wisdoms between modern scientific agricultural knowledge and indigenous knowledge systems. Traditional resource-management practices and the knowledge of ecosystem processes upon which they are based are embedded in often elaborate social institutions. A major task then is to identify and assess the traditional knowledge framework and resource management practices used by individuals and communities, illustrating their value as a basis for the

sustainable management of local agricultural systems. This can only occur from integrative studies using agroecological and ethnoecological methodologies, which when used together can help determine the myriad of factors that condition how farmers perceive their environment and subsequently how they modify it, to later translate such information into practical management schemes that promote the dynamic conservation of indigenous agroecosystems (**Figure 2**).

**Figure 2.** *Agroecology and ethnoecology as key disciplines in understanding how farmers perceive and modify nature. Ethnoecology allows understanding of farmers' rationale and knowledge and agroecology explains why traditional systems work and have stood the test of time.*



Thus the combination of formal western science and ethnoscience provides the principles to design and manage sustainable farming systems. Such principles will take specific technological forms according to local socio-economic and environmental conditions, and in order for these technologies to be relevant to farmers' needs and circumstances, they must emerge from a participatory research process in which farmers are key participants in testing, evaluating and disseminating the best agroecological techniques.

#### WHY A NEW INTERNATIONAL AGROECOLOGY TRAINING PROGRAM?

Unfortunately very few agricultural colleges and universities in the world have incorporated agroecology and the concept of sustainable rural development into their formal curricula. The problem is that the majority of professionals in agriculture have

being trained from a disciplinary and reductionist perspective with specialization in one component of the whole agrarian system (its economy, a group of crops, soils, entomology, etc.). This specialization constitutes more a barrier than a bridge toward the understanding of agricultural systems, and has impeded agricultural researchers in appreciating the complexities of the social, economic and ecological processes that characterize today's agriculture. As the need grows to understand the process and integration of agriculture more globally and to incorporate sustainability criteria in the evaluation of agriculture, the training of agricultural professionals of the 21<sup>st</sup> century should necessarily incorporate in the conventional curriculum more integrated approaches such

as agroecology and sustainability issues. Agroecology can help in the design of a curriculum to build this capacity in students, making them better prepared to face the future challenges of agricultural development in the region. The professionals of the future should understand that the improvement of agriculture is intimately linked to advances in the social, cultural, environmental and economic spheres. The problems of rural development are more than technical problems, and these should be resolved at local as well as regional, national and international levels.

A rapid way to correct this educational deficiency would be to create an international program of Agroecology which would redesign the educational process in agriculture in new and creative ways. The idea is to train a critical mass of students from different parts of the world with the skills to deal with the intricacies of sustainable systems and to guide agriculture in various temperate and tropical regions through a path that sustains productivity while conserving natural resources, biodiversity and cultural traditions, in socially equitable and economically viable ways.

Several universities in Europe and Latin America offer bachelor and Master's programs in Agroecology (Universidad de Barcelona, Universidad de Cordoba-Universidad Internacional de Andalucia, IAM in Bari, Università degli Studi di Firenze, Università degli Studi della Toscana, Universität Kassel, Norwegian University of Life Sciences, Universidade Federal de Santa Catarina in Brazil, AGRUCO in Bolivia and a few others). Such

efforts reflect the growing awareness for the need to design a new agriculture that enhances the environment, preserves local cultures and associated biodiversity and promotes food sovereignty and the multiple functions of small farm agriculture. Most programs however emphasize either the ecological or agronomic disciplines, while others are strong in the social, cultural and humanistic disciplines, not allowing students to gain a broad perspective on the ecological, technical, social, economic and policy dimensions of agroecology. A new program would revolve around the sustainability of agriculture, including the themes of vitality of rural communities, maintaining local cultures and gastronomies, reducing off-farm and energy inputs, conserving biodiversity and



maximizing the use of ecosystem services to meet production goals with reduced impact on the environment.

The program would bring together the expertise on agroecology available among researchers, professors and development specialists from the best universities and organizations of Latin America, the United States and Europe. It would be designed to be flexible and organized in technical, methodological, socio-economic and practical modules, which will provide students with knowledge about concepts, methods, tools and best practices applied to agroecology. The program will equip students with theoretical and methodological foundations for agroecosystem analysis and redesign. The academic approach would be mainly experience-based learning via field experiments and farm surveys, supported by lectures, seminars and supervised independent studies. The core of the international faculty will ensure that students develop agroecological knowledge and skills for excellence in research and practical problem solving.

The strength of the program would lie in its practicality. Coursework would be complemented by a series of activities such as problem-based learning, case-study analysis, and practical experience through direct involvement in field research and visits to farmers' fields. With such tools students would be able to guide agriculture in various parts of the world through a path that sustains productivity while conserving natural resources, biodiversity and cultural diversity, in socially equitable and economically viable ways. Because of its international nature, the presence of instructors and students from around the world would ensure a multicultural environment, providing students with opportunities to gain cross-cultural experience and geographic exposure thus enhancing their international experience and common understanding of rural issues around the world. By addressing similar questions and problems affecting agroecosystems in temperate and tropical regions, students will engage in cross-regional comparisons and interdisciplinary analysis. Agroecology graduates will understand that agriculture is a biological and ecological activity, which at local and global levels is profoundly linked to socio-economic and cultural systems and cannot be treated separately. They will also appreciate the importance of a more balanced and equitable market system and the need for conducive policies that support farmers in terms of providing them with access to land, water, seeds and agroecological approaches.

#### THE UNIQUE FEATURES OF THE NEW CURRICULUM

The new agroecology curriculum would include courses in ecological sciences which provide a broad knowledge of organisms (including plants, animals and microorganisms) and the physical and chemical characteristics of environments. Agroecology students will develop a strong knowledge of the diversity of organisms and how they interact in managed ecosystems. Furthermore, the curriculum builds on this knowledge, providing courses that demonstrate the application of ecological principles to manage agroecosystems at the field and landscape level.

As students will be coming from several parts of the world, it will be critical to confront the fact that the variability of ecological processes and their interactions with



heterogeneous social, cultural, political, and economic factors generate a diversity of farming systems that are exceptionally unique. When the heterogeneity of the rural landscapes is considered, the inappropriateness of technological recipes or blueprints becomes obvious. The only way that the specificity of local systems—from regions to watersheds and all the way down to a farmer's field—can be taken into account is through site-specific agroecological research. This does not mean however that agroecological schemes adapted to specific conditions may not be applicable at ecologically and socially homologous larger scales. What is implied is the need for students to understand the

principles that explain why such schemes work at the local level, and later applying such principles on broader scales.

Site-specificity requires an exceptionally large body of knowledge that no single research institution or group can generate and manage on its own. This is one reason why a multidisciplinary team of faculty and students and the inclusion of local communities at all stages of projects (design, experimentation, technology development, evaluation, dissemination, etc.) is a key element in successful rural development. The inventive self-reliance of rural populations is a resource to be urgently and effectively mobilized. For this reason the new program would train students in participatory methods of research and development in order to enhance human resource development as the cornerstone of any strategy aimed at increasing options for rural people.

On the other hand, students will be aware that technological or ecological intentions are not enough to disseminate agroecology. Major changes must be made in policies, institutions, and research and development agendas to make sure that agroecological alternatives are adopted, made equitably and broadly accessible and multiplied so that their full benefit for sustainable food security can be realized. It must be recognized that a major constraint to the spread of agroecology has been that powerful economic and institutional interests have backed research and development for the conventional agroindustrial approach, while research and development for agroecology and sustainable approaches has been largely ignored or even ostracized. This new international program would reverse such tendency and would capitalize on the growing realization of the advantages of alternative agricultural technologies.

The curriculum will expose students to a myriad of diversification schemes favoring food security and a better use of agrobiodiversity and local resources, and will emphasize human capital enhancement and community empowerment through training and participatory methods as well as higher access to markets, credit and income-generating activities.

#### **Proposed themes for training modules:**

- History and development of agriculture: food, land, energy and population
- The ecological crisis of modern agriculture
- Principles and fundamentals of agroecology
- Biotechnology: social and environmental implications
- The ecological role of biodiversity in agroecosystems
- Ecologically based insect pest management: biological control and habitat management
- Ecological basis of weed and disease management
- Topics in soil ecology and management
- Ethnoecology: traditional agriculture and indigenous knowledge systems
- Agroecosystem diversification strategies (polycultures, agroforestry, crop rotations, cover cropping, integrated crop-livestock systems, etc.)
- Organic farming: characteristics, extent and conversion
- Applying agroecology to rural development in the Third World
- Participatory research and agroecosystem analysis methods
- Ecological economics: agricultural applications



- *Ethnoecology and traditional farming*: indigenous knowledge systems (IKS), integration of IKS and modern science, improving peasant farming systems, in-situ conservation of local agro biodiversity, etc.
- *Sustainability in the food and agriculture system*: Social, cultural and economic dimensions of sustainability in food systems, with emphasis on conducive policies, alternative marketing, etc.
- *Rural development*: sustainable development at the local level, community food security, land reform, participatory methods, social movements in agriculture, etc.

#### STUDENT PROFILE

After graduation students are expected to possess a strong theoretical background, methodological-analytical and practical skills in agroecology. Thus the profile of graduating students would be characterized by:

- A strong theoretical and conceptual background on agroecology and sustainable development, including practical know-how on crop, soil and biodiversity management and able to integrate socio-cultural dimensions
- Knowledge and skills regarding the design, management and evaluation of diversified and complex agroecosystems
- A strong grounding in quantitative methods to evaluate performance of agricultural systems and to analyze and interpret scientific data
- Ability to participate in multidisciplinary teams, engage in participatory processes including farmers and other actors, explicitly incorporating multi-ethnic and gender relations
- Appreciation of traditional forms of agriculture, ability to mobilize local skills, technologies and resources for endogenous development
- High capacity to systematize and evaluate local development experiences and to set in motion a scaling-up process of successful agroecological initiatives
- The capacity to understand and to act accordingly in economic, social, cultural and political processes conducive to sustainable local development, via empowering social groups, conducive policies, alternative markets, etc.

This new agroecology program would be suitable for students in the natural and social sciences and for professionals involved in technical, socio-economic or cultural aspects of agriculture. It is appropriate for those who wish to work on the many aspects of sustainable agricultural development.

The program will produce graduates well-placed for careers in the areas of organic agricultural production, rural development, consulting, agricultural policy analysis and implementation and research with farmers' organizations, NGOs, universities, international organizations and research centers.