Agroecology: concepts, principles and applications

Contributions by the Sociedad Cientifica LatinoAmericana de Agroecologia (SOCLA) to FAO's International Symposium on Agroecology for Food Security and Nutrition

1. Agroecology is the science that provides the basic ecological principles for how to study, design and manage agroecosystems that are both productive and natural resource conserving, and that are also culturally sensitive, socially just and economically viable.
2. Agroecology goes beyond a one-dimensional view of agroecosystems - their genetics, agronomy, edaphology, etc., - to embrace an understanding of ecological and social levels of co-evolution, structure and function. Instead of focusing on one particular component of the agroecosystem, agroecology emphasises the interrelatedness of all agroecosystem components and the complex dynamics of ecological processes that drive productivity, stability and resilience. Agroecology integrates natural and social processes joining political ecology, ecological economics and ethnoecology among the hybrid disciplines. Agroecology uses a systemic approach therefore it has long been considered a transdiscipline as it integrates the advances and methods of several other fields of knowledge around the concept of the agroecosystem viewed as a socio-ecological system.
3. Agroecology aims at the holistic study of agroecosystems which are seen as complex systems in which ecological processes occur, e.g. nutrient cycling, predator/prey interactions, competition, symbiosis and successional changes. Implicit in agroecological research is the idea that, by understanding these ecological relationships and processes, agroecosystems can be manipulated to improve production and to

produce more sustainably, with fewer negative environmental or social impacts and fewer external inputs.

4. At the heart of the agroecology strategy is the idea that an agroecosystem should mimic the functioning of local ecosystems thus exhibiting tight nutrient cycling, complex structure, and enhanced biodiversity. The expectation is that such agricultural mimics, like their natural models, can be productive, pest resistant and conservative of nutrients.
5. Learning from nature allows development of agroecosystems with a minimum dependency on agrochemical inputs and energy, emphasizing interactions and synergisms among the many biological components of agro-ecosystems to enhance recycling and biological control, thus improving overall ecological efficiency and environmental protection.
6. A key agroecological strategy in designing a sustainable agriculture is to reincorporate diversity into the agricultural fields and surrounding landscapes. Diversification at the field level occurs as variety mixtures, rotations, polycultures, agroforestry, crop-livestock integration, etc and at the landscape level in the form of hedgerows, corridors, etc, giving farmers a wide variety of options to assemble spatial and temporal combinations. Emergent ecological properties develop in diversified agroecosystems allowing the system to function in ways that maintain soil fertility, crop production, and pest regulation. Agroecological management practices that increase agroecosystem diversity and complexity act as the foundation for soil quality, plant health and crop productivity.
7. Biodiversity enhances agroecosystem function because different species or genotypes perform slightly different functions and therefore have different niches In diversified agroecosystems there are many more species than there are functions and thus redundancy is built into the agroecosystem. Those components that appear redundant at one point in time become important when some environmental change occurs. As environmental change occurs, the redundancies of the system allow for continued ecosystem functioning and provisioning of ecosystem services. On the other hand a diversity of species acts as a buffer against failure due to environmental fluctuations, by enhancing the compensation capacity of the agroecosystem. If one species fails,

others can play their role, thus leading to more predictable aggregate community responses and maintenance of ecosystem properties

8. The design of such agroecological systems is based on the application of the following e principles:
    - Enhance recycling of biomass and optimizing nutrient availability and balancing nutrient flow.
    - Securing favorable soil conditions for plant growth, particularly by managing organic matter and enhancing soil biotic activity
    - Minimizing losses due to flows of solar radiation, air and water by way of microclimate management, water harvesting and soil management through increased soil cover.
    - Species and genetic diversification of the agroecosystem in time and space at the field and landscape level.
    - Enhance beneficial biological interactions and synergisms among agrobiodiversity components thus resulting in the promotion of key ecological processes and services.
9. Agroecological systems are deeply rooted in the ecological rationale of traditional small-scale farmers who for centuries have developed farming systems that offer promising sustainability models as these systems promote biodiversity, thrive without agrochemicals, and sustain year-round yields meeting local food needs. The evolution of these systems has been nourished by complex forms of traditional knowledge. Many farmers possess a detailed folk knowledge about vegetation, animals, soils, etc, within a certain geographical and cultural radius. Rural knowledge is based on observation and on experimental learning. Successful adaptations are passed from generation to generation and historically farmers have shared successful innovations with neighbors.
10. Small farming systems not only have fed much of the world population for centuries and continue to feed people in many parts of the planet, especially in developing countries, but also have the potential to bring solutions to many uncertainties facing humanity in a peak oil era of global climate change and financial crisis. Recent research has demonstrated that small diverse farms are more resilient to droughts and hurricanes. Undoubtedly, the ensemble of traditional crop management practices used

by many resource-poor farmers represent a rich resource for agroecologists seeking to create novel agroecosystems well adapted to the local agroecological and socioeconomic circumstances of smallholders. Agroecologists recognize and value local wisdom and traditions, creating a dialogue with local actors via participatory research that leads to a constant creation of new knowledge.

11. Agroecology is now the main technological strategy of peasant movements due to several characteristics of the agroecological approach:
    - Agroecology provides methodologies that allow the development of technologies closely tailored to the needs and circumstances of specific peasant communities.
    - Agroecological techniques and designs are socially activating since they require a high level of popular participation.
    - Agroecological techniques are culturally compatible since they do not question peasants' rationale, but actually build upon traditional farming knowledge, combining it with elements of modern agricultural science.
    - Techniques are ecologically sound since they do not attempt to radically modify or transform the peasant ecosystem, but rather to identify management elements that, once incorporated, lead to optimization of the production unit.
    - Agroecological approaches are economically viable by emphasizing use of local resources thus breaking technological dependence by emphasizing use of local resources.
12. A major goal of agroecology is the revitalization of peasant and small family farms and the reshaping of the entire agricultural policy and food system in ways that are economically viable and socially just to farmers and consumers. New approaches and technologies involving application of blended agroecological science and indigenous knowledge systems and spearheaded by thousands of farmers, NGOs, and some government and academic institutions are proving to enhance food security while conserving agrobiodiversity soil and water resources conservation throughout hundreds of rural communities in the developing world.
13. Agroecology is highly knowledge-intensive, and is based on techniques that are not delivered top-down but developed on the basis of farmers' knowledge and

experimentation. For this reason agroecology emphasizes the capability of local communities to experiment, evaluate, and scale-up innovations through farmer-to-farmer research and grassroots extension approaches. Technological approaches emphasizing diversity, synergy, recycling and integration, and social processes that value community involvement, point to the fact that human resource development is the cornerstone of any strategy aimed at increasing options for rural people and especially resource-poor farmers. Agroecology promotes community-oriented approaches that look after the subsistence needs of its members, emphasizing self-reliance and also privileges food provisioning for local markets that shorten the circuits of production and consumption

14. The expansion of agroecology in Latin America and other regions of the world has initiated an interesting process of cognitive, technological and socio-political innovation, intimately linked to the new political scenarios such as the emergence of progressive governments and resistance movements of peasants and indigenous people. Thus the new agroecological scientific and technological paradigm is being built in constant reciprocity with social movements and political processes.
15. Agroecology is not neutral and is self-reflexive, giving rise to a critique of the conventional-industrial agricultural paradigm. The technological dimension of the agroecological revolution emerges from the fact that contrary to Green Revolution and other intensification approaches that emphasize seed-chemical packages and 'magic bullet' recipes, agroecology works with principles that take multiple technological forms according to the local socio-economic needs of farmers and their biophysical circumstances. Agroecological innovations are born in situ with the participation of farmers in a horizontal (not vertical) manner and technologies are not standardized but are rather flexible and respond and adapt to each particular situation. As a science agroecology carries an ecological and social ethics with a research agenda of creating nature friendly and socially just production systems.