

Agroecology: the science to transition organic farming towards a truly sustainable and resilient form of agriculture in the 21st century

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Abstract

Today there is considerable consensus that modern agriculture confronts an environmental crisis. A growing number of people have become concerned about the long-term sustainability of existing food production systems. Evidence has accumulated showing that whereas the present capital- and technology-intensive farming systems have been extremely productive and competitive, they also bring a variety of economic, environmental and social problems. An alternative food system is urgently needed.

From an ecological perspective, the regional consequences of monoculture specialization are many-fold including the high use of agrochemicals (pesticides and fertilizers), and lately the use of transgenic crops, which have increasingly been linked to a an array of environmental problems, the worsening of insect pests and disease infestations and higher vulnerability to climate change. Moreover the efficiency of use of applied inputs is decreasing and crop yields in most key crops are leveling off. In some places, yields are actually in decline. There is no question that high-input conventional agricultural systems need to be converted to systems that require less use of external inputs and that are able to produce high quality food without degrading the environment

On the other hand it is now well accepted that vast areas in the developing world, characterized by traditional/subsistence agriculture, remain poorly served by the top-down transfer-of-technology approach, due to its bias in favor of modern scientific knowledge and its neglect of local participation and traditional knowledge. For the most part, resource-poor farmers gained very little from the Green Revolution. Not only were technologies inappropriate for poor farmers, but peasants were excluded from access to credit, information, technical support and other services that would have helped them use and adapt these new inputs if they so desired. The urgent need to combat rural poverty and to conserve and regenerate the deteriorated resource base of small farms requires an active search for new kinds of agricultural research and resource management strategies. Many people have long argued that a sustainable agricultural development strategy that is environmentally enhancing must be based on agroecological principles and on a more participatory approach for technology development and dissemination.

Agroecology has emerged as the discipline 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. 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. 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. Ecological concepts are utilized to favor natural processes and biological interactions that optimize synergies so that diversified farms are able to sponsor their own soil fertility, crop protection and productivity.

This paper argues that agroecology can provide the scientific and methodological basis for converting organic systems to a more sustainable path of production. Agroecology is also providing a new technological paradigm for resource-poor farmers to achieve productive, energy and food sovereignty. Of course conducive policies, alternative markets and organized social movements are required for agroecology to fulfill its development potential.

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