

Paths towards sustainable agriculture

Introduction

In the Anthropocene, industrialized agriculture has transgressed our planet's limits by having a heavy toll on ecosystems, human health, and climate and also by increasing the vulnerability of rural populations. Worldwide, agriculture occupies 38% of the Earth's land, having a high ecological footprint in terms of water pollution due to pesticides and fertilizers, soil erosion and pollution, biodiversity destruction, and greenhouse gas emissions.¹ These impacts also harm human health² and increase food insecurity among poorer populations.³

This scenario went for worse when the "Green Revolution" was imposed on poorer countries, having been promoted by governments, private foundations and business, all of which promoted the state's withdrawal from agricultural production, leaving agri-food systems in the hands of multinational corporations whom today monopolize agriculture research, seeds, and agrochemicals, as well as food storage and distribution.⁴

For most smallholder farmers and peasants (generally defined as having less than 2 ha), the Green Revolution's promises of rising agricultural productivity and access to credit and technology were dreams that never came true. Instead, it led to overall poverty, pitiful wages, unemployment, migration, and increasing debt due to the acquisition of consumable inputs.

During the last decades, as soils have been losing their fertility, small farmers have been cast out of markets. And now, these farmers have felt a strong need to go back to -as well as innovate in- alternative rural production systems. Even from the very beginning, many resisted using technological packages that threatened their environment, their culture, and their community.

Nowadays, the importance of peasant agriculture has been widely acknowledged. Peasants produce between 28 and 31% of total crop production and between 30 and 34% of the world's food supply,⁵ and furthermore, smallholders produce more food crops than large farms.⁶ Peasants also play a central role in conserving crop diversity and have a better chance in adapting to climate change. A lot of research concerning these production systems has been disseminated by articles, web pages, handbooks, congresses and forums. These sources indicate how these systems share common traits and processes, such as the varied use of biodiversity, closing nutrient cycles, integrated pest management and soil carbon storage. Besides, the knowledge gathered by peasants through experimentation with agriculture endows them with a high adaptive capacity to face adverse circumstances.⁶ However, Green Revolution implementation has been going on for decades, guiding paradigmatically most agrarian policies. Very few countries, like Cuba,⁷ have shifted their agriculture towards agroecological versions. Even though traditional and local knowledge is presently acknowledged as a key component in reaching agriculture sustainability most farmers in developing countries have experienced significant cultural erosion. The breakdown of local knowledge and the weakening of social organization have rendered them both dependent on agrochemicals and vulnerable to the market's ups and downs.

In the face of this situation, diverse strategies are required in order to transit towards a sustainable agriculture. This transition, in turn, is a complex process that articulates different scales (farm, local community, territory) and is influenced by ecological, economic, technological, political, social, and cultural factors. Consequently,

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its implementation cannot consist in applying a single formula. Various experiences show that most farmers begin this conversion process slowly, by taking their time in order to gain experience with these more diversified agricultural systems, by experimenting on a small scale and/or reducing the use of agrochemicals.^{8,9} However, this path is also influenced by each local group's own incentives. Incentives that go from reducing production costs,¹⁰ reducing youth migration and strengthening old and new institutional arrangements to improving one's social position within the community, by being seen as an innovative person who can eventually teach others.⁹

A consensus has been reached on how to achieve both resilient and sustainable agriculture: the co-design of new agroecosystems based on two key features: traditional practices and scientific knowledge. To engage in this process, a few common and necessary steps have already been identified through research, beginning by co-innovation between farmers and researchers, or by building peasant to peasant processes through participatory diagnosis. Either one can enable the production of knowledge that farmers could eventually adapt to their own needs and contexts.¹¹ Some stages include: (1) increasing the efficiency in the use of inputs by means of integrated pest management or integrated soil management; (2) substituting agrochemicals with inputs that are environmentally benign; (3) redesigning the system by diversification, implementing vegetal or animal assemblages that favor synergies so that the agroecosystem can take care of soil fertility, crop productivity, and regulating pests; (4) monitoring and evaluating the process's acceptability, by turning it into a learning process, enabling farmers to gradually gain confidence as to its efficiency.^{11,12-15}

On the other hand, transition towards a sustainable agriculture also requires that agrarian policies must change. Governments play a fundamental role in creating and enabling public policies and initiatives with the appropriate funding in order to foster agroecological projects and programs. Farmers' participation in drawing up public policies, especially small-scale farmers, is key to ensuring that these policies successfully adapt to their needs and diversity.¹¹ Providing scientific knowledge and adapting it to local cognitive forms in order to design cropping systems that resemble ecological principles of sustainability is today a major challenge.

Thus, one of humankind's great and present challenges is the feasible conversion of agricultural systems, by transformation and adaptation, using knowledge governance.

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Conflicts of interest

Authors declare no conflict of interest exists.

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