Advances in Agricultural Technology & Plant Sciences
ISSN: 2640-6586

Mini-Review *Volume 3 Issue 1*

Agroecology: In Need of a Paradigm Change in Agriculture

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Received Date: February 11, 2020; **Published Date:** February 27, 2020

Introduction

Defining Agroecology can be a rather complex task. 1928 is considered to be the birth year of the use of Agroecology as a scientific term, first used in a book by a Russian agronomist [1]. Almost 100 years ago Agroecology was defined as "the use of ecological methods on commercial crop plants", a definition that seems modest and incomplete by 2020s standards. A quick review of modern literature can be more confusing. Agroecology can be defined as "the application of ecological aspects and principles to the design and management of sustainable agricultural ecosystems" [2]. According to the Food and Agriculture Organization of the United Nations (FAO), "Agroecology is a scientific discipline, a set of practices and a social movement. As a science, it studies how different components of the agroecosystem interact. As a set of practices, it seeks sustainable farming systems that optimize and stabilize yields.

As a social movement, it pursues multifunctional roles for agriculture, promotes social justice, nurtures identity and culture, and strengthens the economic viability of rural areas [3]." It is easy to understand that Agroecology can be considered as an applied science provides the knowledge and methodology necessary for the development of agriculture, which is, on the one hand, environmentally sustainable and, on the other hand, highly productive and economically and socially viable. This combination will lead to the development of new paradigms in agriculture, in part because it intersects the distinction between the production of knowledge and its application. It also assesses the local, empirical knowledge of farmers - producers, the sharing and the application of this knowledge to the now common purpose of sustainability.

Problems of Conventional Agriculture

But is a paradigm shift necessary for agriculture? Today the paradigm of conventional industrial agriculture (High External Input Agriculture) is predominant throughout the world with minor alterations [4]. Additionally, most governments' policy and even university and academic research was, up to relatively recently, oriented towards this [5]. Nowadays, it is recognized that conventional agricultural practices degrade the global environment and lead to reduced biodiversity, disrupt the balance of natural ecosystems and ultimately diminish the natural resources on which agriculture and - of course – all humanity are based. In addition, these practices produce greenhouse gases, contribute to the climate change, lead to abandonment of rural land and provides law quality food [6].

Conventional agriculture has achieved high produces mainly by increasing agricultural inputs. These inputs include material components, such as irrigation water, fertilizers and pesticides, the energy used for the production of these materials, the cost of maintaining farm equipment and irrigation systems, and of course, technology in the form of hybrid seeds, new machinery and new agrochemicals. All of these inputs come from outside the agroecosystem and their intensive use has a negative impact on the profits of the farmer / producer. Actually, there is a vicious circle linking conventional farming practices with ever – increasing dependence on external inputs: as intensive cultivation and monoculture degrade soil fertility, nitrogen and other nutrient inputs are increasingly needed.

Therefore, agriculture cannot be sustainable as long as it relies dramatically on inputs, both for environmental and economic reasons. As an example, the natural resources, from which many of the inputs come, are not renewable and their stocks are permeable. In addition, the dependence on external inputs makes agricultural production vulnerable to stock shortages, market fluctuations and price increases. Another result of conventional agriculture, in recent decades,

is the radical degrease of the overall genetic diversity of agricultural plants. Numerous varieties have already disappeared and a significant number of others are heading to the same destination. Meanwhile, the genetic basis of most major crop plants has become largely unvaried. For example, only six maize varieties are used for 70% of maize cultivation worldwide.

A major thread that is already faced by scientist is the loss of agro-biodiversity Agro-biodiversity is a sub-set of biodiversity; it is biodiversity of flora and fauna (including microorganisms) that influences and interacts with agriculture. Agro-biodiversity includes cultivated or non-cultivated crops, forest tree species, livestock and all other macro and micro fauna associated with agricultural environment [7]. Throughout most of the history of agriculture, humans have increased the genetic diversity of crops worldwide. This was achieved both by the selection of a variety of specific and, often, locally adapted traits through plant breeding, as well as by the constant search for wild species to increase the gene pool. However, loss of genetic diversity was mainly due to the emphasis placed on conventional farming based on its short-term benefits. When high-yielding varieties were developed, they tended to be accepted at the expense of other varieties, even when the ones replaced had many desirable characteristics. Genetic homogeneity among crops is also linked to maximum productive efficiency because it is thought to permit the stabilization of specific management practices. However, the real case is quite the opposite: decreasing genetic diversity of crop plants makes them, in their entirety, more vulnerable to infestations of insects and pathogens, which become more and more resistant to insecticides and the defense mechanisms of the plants themselves. Moreover, it also makes the plants more vulnerable to climate change and other environmental factors. This problem is aggravated by the subsequent reduction of the size of the genetic pool of each crop, as we derive robust and adaptive genes from fewer and fewer varieties.

Ecology at the Service of Agriculture

The agriculture of the future, in order to be able to feed the growing human population, must be both sustainable and highly productive. These two challenges suggest that we cannot easily abandon conventional practices and return to traditional, local practices. Although traditional agriculture can provide valuable principles and practices for the development of sustainable agriculture, it cannot produce the quantities of food needed to supply densely populated and, often, remote urban centers and to fully cover its global markets, as it focuses mainly on meeting local and small-scale needs. Consequently, what is needed is a new approach to agriculture and rural development, built on the principles of conservation of traditional, local and small-scale farming, while at the same time using the most innovative knowledge and modern methodology and technology of agriculture. This approach is embedded in the science of Agro-ecology.

Ecology methods and principles are the cornerstone of Agro-ecology, as they are needed to determine whether a particular farming practice or management decision is sustainable. On this basis, it is now possible to develop practices that minimize external inputs - reducing their negative impacts - and introduce planning and management systems that help farmers maintain the health of agricultural land and agricultural activities in the long term. The two sciences from which Agro-ecology originated, that is Agronomy and Ecology, had a connection during the twentieth and the twenty-first centuries. However, ecology was primarily interested in the study of natural systems, while Agronomy engaged in the application of scientific research methods to agricultural practice. The boundaries between pure science and nature on the one hand, and applied science and human living on the other, have kept the two sciences relatively distant, with agriculture still at the center of interest in Agronomy. Only relatively recently, more attention has been paid to ecological analysis of agriculture – but still in a small range.

Organic Agriculture as an Example of Agroecological Approach

Since the 1990s, agro-ecology had emerged as a scientific discipline with a defined conceptual framework and specific methodology for the integrated study of agro-ecosystems, including anthropogenic and environmental elements. According to this holistic view, a site used for agricultural production is regarded as a complex system in which ecological processes coexist with anthropogenic activities (economic and socio-cultural). Agro-ecology thus focuses on the dynamics between these processes. The result of this this new approach is the establishment of the “ecological foundations of agriculture”, that is a set of principles and concepts that help achieve sustainability and provision of environmental and ecosystem services from agriculture. A typical example of agro-ecology application is organic farming. The term organic or ecological farming refers to mild, environmentally friendly farming that is not based on the use of external inputs, such as inorganic fertilizers and chemical pesticides. In particular, organic farming is a production system based on crop rotation, recycling of plant organochemical residues, green manuring, reasonable use of agricultural machinery and biological control of parasites and harmful insects. The right combination of these practices ensures: a) maintaining soil fertility and sufficient plant nutrition and b) controlling crop pests, diseases and weeds.

Organic farming as a policy for rural development responds

to the need for sustainable development while satisfying consumers' desire for greater safety and higher quality food. It is an integrated management and production system that promotes and supports agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It also emphasizes the use of endogenous management tools rather than the introduction of exogenous agents, taking the local conditions and requirements into consideration. The main advantages of organic farming are the implementation of environmental-friendly production methods, sustainable management of natural resources, preservation or even increase of soil fertility, reduction of energy consumption and external resources, strengthening the stability of agricultural ecosystems, production of healthy and safe food and assurance of higher prices for products than conventional. Finally, organic farming is compatible with the particular landscape conditions that are often encountered in Greece. e.g. terraces, or with modern best practices, eg "mosaic" crops.

Recognizing Agroecology

The need of developing and enlarging Agroecology is now recognized by several stakeholders. Not only the scientific community, but also producers, farmers, NGOs, policy makers and governments are gradually adopting attitudes for this important change in agriculture. The international FAO Agroecology Symposium in Rome, held in April 2018 with more than 700 participants, show the way towards the need of radical decisions that should be made [8]. European Union has developed, approve and promote several directives and plans in an effort to minimize the negative effects of conventional agriculture, such as the European Union (EU) Common Agricultural Policy (CAP), the EU Nitrate or Water Framework Directives and nature conservation policies such as the NATURA 2000 network of protected natural areas [6]. Considering the above advantages, is this what primary production needs today? If so, then agro-ecology is not a utopia.

References

1. Wezel A, Soldat V (2009) A quantitative and qualitative historical analysis of the scientific discipline of agroecology. Inter J Agri Sustain 7(1): 3-18.

2. Gliessman SR (2014) Agroecology: The Ecology of Sustainable Food Systems. CRC Press, Environ Agri pp: 405.

3. High Level Panel of Experts on Food Security and Nutrition (2019) Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. The Food and Agriculture Organization pp: 1-163.

4. Arizpe N, Giampietro M, Ramos-Martin J (2011) Food security and fossil energy dependence: An international comparison of the use of fossil energy in agriculture (1991–2003). Critical Reviews in Plant Sciences 30(1-2): 45-63.

5. Valenzuela H (2016) Agroecology: A Global Paradigm to Challenge Mainstream Industrial Agriculture. Horticulturae 2(1): 2.

6. Migliorin P, Gkisakis V, Gonzalvez V, Raigón D, Barberi P (2018) Agroecology in Mediterranean Europe: Genesis, State and Perspectives. Sustainability 10(8): 2724.

7. Joshi, Chouhan K (2020) Biodiversity in agro-ecosystem: conserving micro and macro diversity through sustainable agriculture. J Advan Res Applied Sci 7(1): 23-26.

8. Wezel A, Goette J, Lagneau E, Passuello G, Reisman E (2018) Agroecology in Europe: Research, Education,Collective Action Networks, and Alternative Food Systems. Sustainability 10(4): 1214.