SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL PROTECTION

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"Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone."

Albert Einstein

ABSTRACT – Sustainable agriculture and environmental protection
Human population growth caused the World Commission on Environment and Development to call attention to necesity of changes in strategies for attaining security in food production and conservation of natural resources and enviromental protection. Sustainable agriculture goals may be shortly abridged to stable market supply by biologically quality food, on employment of rural population and suppressing of poverty, as well as natural resources management and environment protection on local and global level. For the system of such sustainable and organic agriculture, ecology provides basic conditons through the development of diversified agroecological systems. Integration of plant and animal biodiversity which improves ineractions and sinergy is the advantage. It enables biological regulation of harmfull organisms, nutrition circling, biomass production and accumulation. The end result is improvement of economical and ecological agroecology system maintenance. In accomplishing these aims new initiatives in education, application of economical stimulations and development of relevant new technologies are included.

Key words: sustainable agriculture, agroecology, biodiversity, biological control

INTRODUCTION

Modernization of agriculture often disrupted the balance between ecology and agricultural production, ignoring or neglecting ecological principles (WEBSTER, 1997). An increasing number of agricultural experts realized that modern agriculture will soon face a crisis, and public in many countries became concerned about the continuation of the current agricultural production system.

Amongst these negative consequences, the most important are: depletion of soil, ground water pollution, reduced number of family farms, deteriorated working and living conditions of rural population, production costs growth and destruction of economic and social conditions in rural communities.

The evidence have accumulated showing that system that favours highly productive and competitive capital intensive technologies and production, also causes ecological, economic and social problems (BOSKOVIC *et al*., 2003). The nature of the current agricultural structure and prevailing strategies in agriculture have led to damaging the environment, mostly favoring large farms, specialized production, crop monoculture and mechanization.

THE EFFECTS OF CONVENTIONAL AGRICULTURE

Today, as more and more manufacturers join in the international economy, the imperative for diversity disappears and economic mechanisms have awarded monoculture as a mode of production (IKERD, 2010). In turn, lack of crop rotation and production diversity removed key regulatory mechanisms in turning monocultures into agro-ecosystems that are vulnerable and dependent on high dosages of chemicals (ASTHANA and KUMAR, 2008).

From the ecological point of view, there are multiple regional consequences of monocultural specialisation:

- Agricultural systems growing specialized crops in vast cultivated lack the components of the former farms having almost entirely lost links and complementarity between the crop production, soils, crops and animals.
- Circulation of nutrients, energy, water and waste no longer exists and the circuit is open as opposed to natural ecosystems.

Despite significant amounts of crop residues and manure produced on farms, it has become difficult to secure the circulation of nutrients, even within agricultural systems. It is no longer financially justified to return the manure into the nutrients circulation process, since the productive land and animal farms are geographically distant. In many areas, agricultural residues have become a burden rather than a source of nutrients.

It is also impossible to recycle nutrients from urban waste material, because of distance that makes it not financially justified.

- Partially, instability and vulnerability of agroecosystems to diseases can be attributed to monoculture production on vast areas, concentrating high amounts of food for harmful specialized herbivores and increasing the area available to immigration of pests. By ecosystems simplification, pests' natural predators are also diminished. In connection with these pest problems, there is always a possibility of new pests introduction or growth inhibition of beneficial insects.

The first wave of environmental problems is caused by monoculture system that favours the use of high technologies and farming practices that degrade natural resources. Therefore, the problem of agricultural production can not be viewed only as a technological problem but also as a social, cultural and economic problem, that contributs to the crisis in these areas (ZECEVIC *et al.*, 2010).

REASONS FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

Despite the growing awareness of the effects of modern technologies on the environment, due to pesticides in food chain and plant nutrients in rivers and groundwaters, there are still those who oppose the challenges of the 21st century, arguing that intensification of agriculture should continue.

Researchers are increasingly showing that it is possible to provide a balanced environment, sustainable production and yield, achieved by biological soil fertility and natural pest control through the organization of diversity in agroecosystems, using technologies that require less investment (ALTIERI, 1993).

Such alternative crop production systems have already been tested, some of them being crops in alternate plots, growing protective crops in orchards and cultivation of intercrops.

Data obtained at farms that implement alternative ways of growing show optimal circulation of nutrients and organic matter as well as closed flow of energy, contributing to the protection of water layers in the soil and the soil structure (HOJKA *et al*., 2006). In addition, balanced number of harmful organisms and their natural predators is established.
Optimal planning and functioning of agroecosystems depends on the degree of interaction between its various abiotic and biotic components (IKERD, 2010). Successfully established functional biodiversity will initiate synergistic relationships that can facilitate specific agro-ecological mechanisms, such as activation of soil organisms, nutrient circulation, increasing number of beneficial arthropods and antagonists, etc.
There are a number of available organizing modes of such production, which vary in strategies applied as well as in the achieved effects (OECED, 1998).

AGROECOLOGICAL PRINCIPLES IN SUSTAINABLE AGRICULTURE

To restore agricultural production that is both ecological and efficient, it is important to thoroughly understand the nature of agroecosystems and the principles on which they work. Agroecosystems are communities of plants and animals developing mutual relationships, as well as relationships with external physical and chemical conditions, modified by man. Thay can be manipulated to improve production in terms of sustainable agriculture, with fewer negative effects (BOSKOVIC *et al*., 2010). Agroecology is a discipline that creates a strategy for agro-production and is oriented towards the conservation of natural resources. It studies agroecosystems with their genetics, land configuration, external conditions and human influence, and incorporates understanding of environmental and social achievements of co-evolution, its structure and function. This way it emphasizes the inter-connection of all components of agroecosystems and the dynamics of complex ecological processes (HERDT *et a*L., 1995).
Creating such systems is based on the application of ecological principles, such as:
• Increase biomass recycling and optimizing available nutrients balancing their flow.
• Securing favorable soil conditions for plants, especially through organic matter management and increasing soil biotic activity.
• Reduction of losses due to the influence of solar radiation, air and water through microclimate management.
• The genetic diversification of agroecosystems in time and space.
• Increase of favorable biological interactions and synergism between components of agrobiodiversity, enhancing basic ecological processes.

BIODIVERSITY IN SUSTAINABLE AGRICULTURE

Agricultural biodiversity of all specii intended for human food is a significant part of biodiversity in general, highly considered in food market globalisation, intelectual property system and spreading unsustainable industrial food production. It is also known as agri-biodiversity or the genetic resourses for food and agriculture. It includes:

- harvested types of crops, selected animal specii, various fish specii, wild resources in the fields, forests and aquatic ecosystems;
- not harvested specii within production ecosystems that support food supply, including soil micro-organisms, pollinators, etc.;
- not harvested specii in the broader field conditions that promote food production ecosystems (agricultural regions, forest and aquatic ecosystems).

However, the interaction between the environment and genetic resources management practice determines evolutionary processes. These may include introgression from wild relatives, hybridization between cultivated plants, mutation of natural and artificial selection, since the genetic material (variety of farm crops or domestic animals selected) is well adapted to local variations in biotic and abiotic external conditions.

BIODIVERSIFICATION IN SUSTAINABLE AGRICULTURE

Biodiversification of sustainable agroecosystem can be achieved through reviving functional biodiversity, thus initiating synergisms that provide environmental conditions, such as soil biology activation, nutrient cycle re-establishing, increasing favorable arthropods and antagonists. Key actions are preventive, providing strengthening of agroecosystems' "immunity", through series of mechanisms (PRETTY, 1995). Those mechanisms include:

1. Diversification of plant specii and genetic diversity in time and space.
2. Increase in functional biodiversity (natural enemies, antagonistic organisms etc.)
3. increase in soil organic matter and its biological activities.
4. Increase in soil layer that positively affects the crop.
5. Removal of toxic residuals.

Different biodiversification strategies based on ecological principles

Biological diversification in agroecosystems can be performed by:

1. Crop rotation. Occasional diversification provides crops feed and terminates life cycles of some insect pests, parasites and weeds.
2. Polyculture. The complex system of plant crops in which two or more crops are sown within sufficient spatial proximity, which results in competition or complementarity to increase yield.
3. Agro-forestal systems. Agricultural systems where the forest trees are grown together with annual crops and domestic animals, resulting in increased complementary relations between components with multiple use of agroecosystems.
4. Leguminous crops. The use of pure or mixed cultures of legumes or other annual plant species under fruit trees to increase soil fertility, while increasing the biological pest control with modification of orchards microclimate.
5. Integration of domestic animals into agroecosystems contributes increase in biomass production and optimal cycling of nutrients.

Dimensions of agricultural diversity

Agricultural biodiversity has a partial, temporary and graded dimensions at the level of agroecosystems. These agroecosystems, e.g. ecosystems applied in agriculture, are determined by three series of factors: genetic resources, physical external conditions and human production management.

In reality, there is not a system in the world that would be "natural", in the sense that human influence is annulled. Most ecosystems have, to certain degree, been modified or culticated by human activites directed towards food production and satisfying other needs (ALTIERI, 1995).

Agricultural diversity is not purely a result of human activities. Man's life is entirely dependent on it, not only for obtaining immediate food and other goods, but also to maintain areas of land that will sustain production on a large (COPPER *et al*., 1998).

AGROECOLOGY AS THE BASIS OF SUSTAINABLE AGRO-ECOSYSTEMS

Implemented systems of sustainable agriculture seek to maintain productivity in the long run by:

a) optimizing the use of locally available resources by combining different components of the farm system so that they condition each other and have the highest possible synergistic effects;

b) reduction of external influences that are potentially harmful to the environment and health of farmers and consumers;

c) use of resources of the agroecosystem itself (the circulation of nutrients, improved conservation);

d) balancing crop properties and production potential, limiting external climate and land conditions to ensure long term sustainability of the existing level of production;

e) conservation of biological diversity in natural and cultivated land areas, by optimum use of biological and genetic resources of plant and animal specii;

f) use of local knowledge and practices, including innovative approaches that are not fully clarified by scientists but used by farmers.

CONCLUSION

The concept of sustainable agriculture, although controversial because of its various interpretations, clearly is necessary because it involves a series of adjustments in agriculture, based on the understanding of co-evolution of social economic and natural systems. Sustainable agriculture is usually defined as an agricultural methodology that is economically viable, meets human need for food, and at the same time has positive impact on the environment and quality of life. As these goals can be achieved by

various methods, sustainable agriculture is not tied to any particular technological process. Sustainable agriculture is also not in exclusive dependence of organic farming.

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