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## **THE IMPORTANCE OF AGROBIODIVERSITY FOR AGROECONOMY UNDER THE INFLUENCE OF CLIMATE CHANGE**

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**Abstract:** Food and its production represent a fundamental link between human society and its environment. This direct and multiple connection reflects a multitude of environmental influences and conditions, making agriculture one of the most significant, complex, and sensitive socio-economic activities. In this primary economic activity, in the millennia-long history of humanity, the basic goal is to provide a sufficient quantity of quality food for the population, that is to say, the optimal ratio of invested funds and produced profit. In order to meet economic criteria, the diversity of plant and animal species was significantly reduced in the 20th and early 21st centuries, with incalculable consequences for agrobiodiversity and the systemic functioning of the agroecology. The aim of this paper is to highlight the importance of agrobiodiversity for a sustainable agroecology in the face of evident climate change at regional and global levels.

**Keywords:** Agrobiodiversity, Agriculture, Agroecology, Climate

### **INTRODUCTION**

Climate represents a complex system of conditions and influences in which a relatively stable relationship between water, land and air functions in one region, which is to say, it is the whole of the balanced influence of energy, water and carbon cycles. (Vuković et al., 2024). Climate denotes the totality of meteorological factors which mark a relatively stable state of weather phenomena within a region for a long period of time. Climatic conditions represent one of the most significant natural sources for economic and overall social development because they provide relatively stable natural conditions for the growth of economy. Climate directs the entire human activity, from the production of food and clothing, over the construction of appropriate shelters/settlements, to large drainage and irrigation infrastructural projects. The climate of a certain region is influenced by multiple factors, such as astronomical ones (rotation of the Earth and activity of the Sun), geographical (relation between land and sea, latitude) and meteorological (heat, precipitation).

Even in the oldest periods of human society's development, groups and communities either adapted to climatic conditions or migrated under the influence of (un) favorable conditions, both in order to ensure the desired stable and suitable conditions for economic activity. At the same time, society itself, with its economic and overall cultural activity, significantly influenced the intensification or migration of climate manifestations. This was present in several ancient civilizations, and particularly in the last and present century, when CO<sub>2</sub>

emissions reached levels that rapidly changed global climate conditions and caused an ecological crisis.

This notwithstanding, social organization and technology are capable of directing a community so as to survive and achieve some comparative advantages. For most of history, climate changes occurred through natural astronomical, meteorological, and accidental changes while humans had few organizational and technological resources to conform with or adapt to these changes. They opposed the climatic changes by becoming organized (by launching large melioration infrastructural projects as far back as in the old century) or by migrating to more convenient regions. In the last two centuries, there has been an unprecedented global impact of human economic activity on global climate changes along with a simultaneous inconceivable increase in technological and organizational capacities of mankind.

At the very early stages of its development, agriculture aimed at ensuring an adequate selection of plant and animal species that would provide a stable quantity of population quality food. As a rule, the process proceeded in the direction of selection and reduction of species for agricultural production, which resulted in agrobiodiversity being gradually lessened. Only in recent decades has there grown an awareness of the importance of old but presently commercially marginalized plants and animal species and the activity on their preservation.

Until the very seventies of the last century (Giddens, 2010), there was a widespread scientific belief that the potential of man and society to use science, technology and organization to gain power over climate is almost unlimited. At the same time, indisputable historical and archeological proofs came to light, indicating that many social communities either vanished or faced a significant and long-term recession right under the influence of climatic changes. The reliance on monocultures and the reduction of agricultural species proved to be unsustainable due to the lack of agro-economic adaptation to climatic changes.

On account of considerable economic difficulties in the fields of energy and agriculture, ecologists and economists started intensifying scientific activity on mapping and defining climate changes which became the ones of the basic features of ecological crisis. In contemporary conditions, the existence of climatic changes is not questioned in science (Luković and Burić, 2023) but are raised the issues of slowing down these changes and mastering them, as well as establishing the adaptation to them. The consequences of climate change are global as they affect the entire planetary living world and, in particular, global agricultural and economic activity.

### **Biodiversity as a Development Factor**

In relation to climatic changes, the socio-economic scenario (Vuković et al., 2024) reflects on the number of inhabitants, use of resources and land, average income and the level of inequality in society, while the richness of flora and fauna is considered only within the framework of the sustainability of regional or global economies. However, if social development is viewed inclusively and integrally, the protection and preservation of biodiversity is an inseparable and indispensable component.

Along with climate, the richness and diversity of the plant world is an indicator of the quality and preservation of soil and thus, as a factor of development, it directly affects a number of economic branches, such as agriculture, forestry, the construction industry, etc. Agrobiodiversity consists of the diversity of cultivated plant and animal species which are grown in an organized manner in agricultural production to ensure the population's nutrition with foods of plant and animal origin.

Economic laws (Stern, 2007) and profit-oriented economy require agricultural specialization and monoculture production so that the highest possible yields can be ensured. Whether it is plant or animal production, the need for the largest possible quantity of food is achieved by selecting those agricultural and livestock species which will, with the lowest investments, result in the highest yields, while the production of those species which in certain conditions give poorer yield is either suppressed or demotivated. In this way production costs are reduced, yields increased, market dominance ensured, and the prospects to control the entire process enhanced. Apart from intensive agricultural production, other causes of agrobiodiversity loss are also the use of plants and animals for industrial and energy purposes (soy, corn, rapeseed), clothing production (linen and cotton) and state subsidies for certain high-yielding species.

In modern social ecology there is a prediction about the protection of agrobiodiversity which aims to scientifically understand and anticipate the difficulties related to climatic changes and the loss of plant and animal species. Thus, according to Cifrić (2012) these are the following challenges:

- 1) expansion of property rights and restriction of access to seed material by "intellectual property" and patenting that creates monopoly rights (GMOs),
- 2) biomass cultivation for energy purposes which quadrupled between 2000 and 2005 and
- 3) climate change (global temperature rise, extreme weather conditions).

The first challenge of agrobiodiversity is primarily related to GM agriculture, that is, to such production in which "genetically engineered seeds" (GMO) are used with an aim to obtain higher yields and greater resistance to diseases and pests. GM agriculture itself is a very controversial topic in the scientific and professional public, both in the ecological and health aspects, as well as in the economic and social aspects. In the beginning, perhaps the least problematic issue was the economic aspect of GM agriculture, as cheaper agricultural products and their larger quantities are provided in this way. Cifrić (2012) explains the questionability of the economic aspect by taking the example of Argentina, where the initial economic success of increasing the quantity of products was quickly called into question by the devastating consequences in the form of land degradation, a decrease in yields of up to 15%, the collapse of agribusiness in smaller areas, and the growth of unemployment, deforestation in order to obtain arable land, the appearance of more resistant weeds and harmful insects. (Cifrić, 2012).

There is much more disagreement about the environmental and health effects of agriculture which uses GMOs. While some (Jošt and Cox, 2003) emphasize anemia, malnutrition, premature sexual maturity in children, autoimmune diseases and autism, others deny the direct connection between cultivation and the use of GMOs in food and increasing presence of degenerative health problems. In an ecological sense, genetically modified organisms and their mass use in food do not meet the basic principles of sustainability, namely

precaution and risk assessment. GMO supporters do not pay due attention to research work on possible harmful aspects of these foods, which prevents a proactive approach to take place in a number of economic and other social activities. As for the social aspect, the most significant problem is the insufficient transparency of GMO producers and the monopolization of intellectual property. Owners of monopolistic GMO seed material determine the conditions of use and prices, while the producers themselves remain passive "contractors" without the possibility, for example, of harvesting seeds from their plots. Due to all the current and potential risks and problems, it is necessary to involve more intensively independent scientific institutions in transparent research on all aspects of endangering agrobiodiversity through GM agriculture.

Cultivating biomass and using it in the production of renewable energy opens up a significant opportunity to overcome the limitations of non-renewable energy sources. The cultivation of corn and soybeans to produce biofuels used in the internal combustion engines of individual vehicles is above all unethical. As long as there are hungry people on the planet, it is thoroughly against morality to process and use huge amounts of food for the luxury of individual mobility. However, waste from agriculture (straw, corn stalks, waste from pruning), waste from animal husbandry (manure) and residues from wood processing (bark, branches, sawdust) represent biomass with considerable potential for improving agrobiodiversity, in a way that encourages the cultivation of the largest possible number of plants which can contribute to energy sustainability and diversification. On the contrary, the cultivation of a limited and smaller number of wood species with a rapid increase in wood mass can have immeasurable ecological consequences in the case of mass infestation by pests, or in the case of climate changes that would affect their dying out. Attentive, systematic and scientifically inclusive treatment of all aspects of biomass cultivation, along with scientific prediction of possible climate impacts, could have economically profitable effects, without jeopardizing the abundance of plant and animal species along the way.

Climate changes are reflected in the increase in global temperature, increase or decrease in the amount of precipitation, the frequency of extreme weather conditions (long dry periods, floods), the reduction of the global snow and ice cover, the rise in sea level and the increase in economic damages, which are due to the synergistic effect of the mentioned phenomena, and especially due to extreme weather conditions. Although climate changes are not an unambiguously defined global environmental problem, their significance from security and environmental aspects is more than obvious. Apart from this, it has been made evident that deforestation and soil desertification only contribute to more serious consequences for climatic changes. In terms of consequences for the global climate, deforestation of indigenous tropical forests is of particularly devastating outcomes. The loss of these forests may not have directly affected agriculture. Even more, its scale may have been broadened in terms of new arable areas. Yet, the indirect consequences are certainly fatal in ecological and economic sense. We should not forget that the loss of biodiversity of numerous plants and animal organisms entails the direct absence of potential medical, genetic and biological benefits for the survival of mankind on the earth.

### **Agriculture and Agrobiodiversity**

Traditional agricultural production is based on solar energy, biomass, animals and human labor, but in terms of yields, it is multiple less compared to modern food production.

Modern agriculture is based on significant and increasing inputs in the form of artificial fertilizers, pesticides, irrigation and mechanization, all of which are directly related to the availability of non-renewable fossil fuels (Harris, 2009). Since deforestation results in a series of grave consequences for the wider ecosystem in the form of soil erosion and degradation, modern agriculture can no longer rely on new arable land. Illustrating modern agriculture, (Cifrić, 2012) discloses that in Germany in the second half of the 20th century 75% of agricultural and garden grown species disappeared, and that out of 35 known breeds of cattle only 5 are commercially raised. Whereas the elementary economic principle of ensuring the survival and growth of only those species providing the highest yields is applied to agriculture, the ecological principle of diversity, the health principle of resistance, and even the economic principle of diversification is ignored.

In order to enable the sustainability of agriculture in modern conditions, that is, to ensure a sufficient amount of quality food for the population, along with ecological protection of the environment, it is necessary to observe agriculture through an interdisciplinary approach. In other words, it is required the maximum use of renewable resources (waste from the harvest plowed, and manure used as an alternative source of energy); the use of crop rotation along with the necessary fallow land; simultaneous cultivation of several agricultural crops on the same plot to prevent the effects of pests and diseases, as well as to obtain higher yields (legumes and corn); more efficient irrigation methods; minimal plowing techniques, etc.

On a global scale, agricultural production provides sufficient food which is sufficient for the adequate nutrition of every individual in the world (Harris, 2009). In this economic activity as well, the core of the problem lies in inadequate distribution along with the dominance of profit. However, although the quality of nutrition of the population is globally improving, the imbalance is caused by the mismatch between production and distribution. Harris, for example, illustrates this discrepancy by offering some exact data: half of the world's arable land is used for the production of a limited number of cereals while the other half is used for all other crops. To ensure a preferred and dominant meat diet, for example, in the USA three quarters of grain is used for livestock feeding (Harris, 2009).

The reduction of the diversity of cultivated plant and animal species represents a direct reduction of the actual and projected adaptive capacities of an economy. A small number of species of one crop may not make a sufficient biogenetic potential to adapt to current and future climatic changes. A higher level of diversity in agro-economy allows for flexibility in planning, control and community organization for upcoming climate change.

### **Adaptation, Mitigation and Agroecology**

The contemporary global community has the technological and organizational capacities to oppose climatic changes through mitigation or adaptation. Mitigation implies lessening climatic changes impact by reducing the amount of greenhouse gas emissions in order to slow down and prevent the warming of the planet and to stabilize the climate (Vuković et al., 2024). Adaptation represents adjusting to climate changes with the goal of taking measures for sustainable development in climate-changed and unstable conditions, that is to say, the goal of adaptation is to provide sufficient food, preserve the environment and enable stable living conditions. Mitigation is globally oriented and requires international

agreements and voluntary global standardization. Adaptation requires local action and national regulation. However, there is also an overlap of mitigation and adaptation in the cases of use of renewable energy sources, rational consumption of energy, water and soil, reduction of CO<sub>2</sub> emissions, education related to the protection and improvement of the environment, interdisciplinary and inclusive action of various disciplines. It is precisely the fact that these two processes complement and combine in a complete accordance with the motto of sustainable development: "Think globally, act locally"!

Neither mitigation nor adaptation is feasible without scientific and technical means to enable the acquisition of knowledge about the risks, existence and the nature of climate change. Based on such insights, it is possible to approach the planning and organization for mitigation and adaptation processes to take place. While mitigation is long-term and requires complicated consultation processes, and its control is slow and ineffective, adaptation may be performed even in smaller regional areas. Due to this nature of mitigation and adaptation, the study of system vulnerability has become an initial area of research and action.

Vulnerability of social (sub)systems, and especially the economic ones, are basic areas of research in the field of climate changes. Vulnerability can be mitigated by reducing sensitivity and exposure, and by increasing the capacity for adaptation (Vuković et al., 2024). Reducing sensitivity implies enabling different sectors to endure the growing effects of climate changes without major negative consequences. Exposure reduction is the avoidance of the bad impact on certain systems exposed to climatic changes. An increase in adaptive capacity implies such performances of the system by which it adapts itself to changed climatic conditions, that is to say, the system is to become more resistant to climate changes.

In the thematic framework of this paper, increasing the adaptive capacity of agrosystems implies the existence of organizational and scientific-technological processes which will enable the smooth functioning of food production. In this sense, the strengthening of the Global Fund for Crop Diversity ([www.thwgef.org](http://www.thwgef.org)) which puts the protection of agrobiodiversity in direct correlation with climate changes, population health status and economic development. In this framework, the opening of new "seed banks" and national or regional, protected agricultural areas with commercially less profitable plant and animal species represent concrete measures for the protection of overall agrobiodiversity. There are around 1.700 gene banks worldwide ([forbs.n1info.rs/inovacije](http://forbs.n1info.rs/inovacije) from 9/28/2024). Such a "seed bank" in Svalbard, Norway (Svalbard Global Seed Vault) owns and stores 1,300,000 samples from all over the world. Preservation of agrobiodiversity is the basis for the reduction of agricultural production's sensitivity. A greater number of plant and animal species represent a reservoir of genetic diversity that may in the future preserve its adaptive capacity of food production or increase it.

## CONCLUSION

Climate change and the protection of agrobiodiversity are interrelated and conditioned phenomena which considerably affect agriculture, and hence the overall economy. Profit-oriented agriculture strives to provide as much food as possible with as few production costs as possible. For this reason, a whole series of processes is carried out, from the

selection and reduction of species to genetically modified organisms, which all together result in the reduction of plant and animal species grown for food. In the food production industry, climate change has double effects. On the one hand, climate changes affect the reduction of plant and animal species and, on the other, monocultures cause significant problems in the environment and, ultimately, climate change. Conservation of biodiversity and agrobiodiversity becomes a reservoir of diversity that can be used for a successful transition under the influence of climatic changes. In this way, shortages of certain crops or difficulties in breeding certain animal species can be prevented or eliminated.

Global activities in the form of international regulations and the establishment of funds for the protection of biodiversity need to be intensified and strengthened while the awareness of their importance should be expanded among professionals and the public in general. On the other hand, GM agriculture does not have to be a unique activity focused on limiting agrobiodiversity. All the same, it can become more successful if its business and its products are regulated not only for the benefit of private capital, but also for the benefit of the public and the entire society, as well as if the entire production of GMOs is made transparent and if monopolies owned by a few companies are prevented. Interdisciplinary communication is also necessary for comprehensive and scientifically based studies of the health and safety aspects of GM agriculture. Humanity possesses the resources for scientific-technological and organizational activity in the direction of biodiversity preservation and climate changes control, but the issue of choosing global value priorities remains open. Despite the difficulties of global mitigation of climatic changes, the possibility of regional adaptation remains almost unhindered precisely due to the preservation and development of biodiversity and agrobiodiversity.

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