

Chapter 3

Bio–Farming as the Basis of Environmentally–Sustainable Arable Farming at the Time of Global Warming

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ABSTRACT

The concept of environmentally sustainable farming, in which the emission of greenhouse gases into the atmosphere is compensated by the accumulation of organic carbon in the arable horizon and deposited in the subsoil, is substantiated. The rationale for agrotechnical methods to reduce greenhouse gas emissions is given. Authors discuss new approaches to the management of soil fertility, plant productivity, and resistance of agrocenoses, based on the principles of bio-farming, the laws of soil fertility, root-circulation, and the management of edaphy and epiphytic processes. Their use allows one to improve soil fertility and purposefully increase the potential and effective resource of agricultural production. The large-scale implementation of the principles of bio-farming in agricultural production during the global warming requires the elaboration of special programs for the development of the agro-industrial complex, its geo-information support, including monitoring of land fertility using GIS technologies.

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INTRODUCTION

The agro-industrial complex is a source of food for the population and, at the same time, an important link in the carbon exchange chain in the Earth's atmosphere (Schahczenski & Hill, 2008). According to expert estimates, about 2.8 billion hectares of land can be used in world agriculture, while only 1.5 billion hectares are used. The remaining 1.3 billion hectares are lands with soils that are difficult to develop or have lost their natural properties. Over two thousand years of civilization, as a result of the irrational activity of mankind, about 2 billion hectares of once fertile lands have been withdrawn from circulation. They are transformed into man-made deserts and degraded, unsuitable for agricultural land; moreover, they have been lost not only for mankind, but also for the entire biosphere of the Earth (Adeel, Safriel, Niemeijer & White, 2005). The changes were irreversible and unpredictable in their consequences (World Agriculture, 2019). Climate change poses an environmental threat to the future of the Earth's Biosphere (IPCC, 2007). Biodiversity adapts to all climate changes that previously occurred through complex migrations of species, the extinction of some species and the emergence of others. Global deforestation and land replacement with agricultural land accelerates the process of reducing biodiversity. There is a spontaneous transformation of the structure of communities, their stability decreases.

Resistance is the ability of a system to withstand the effects of external factors, while retaining its structure and functions (resistance), as well as restoring them in the event of a violation (elastic stability). Sustainability is a key feature of any production system and can be determined through adaptation (Ovsyannikov, 2000). Adaptation is considered as a property of the system to maintain homeostasis, i.e. self-regulation, maintaining the constancy of the internal state as a result of coordinated actions as a result of dynamic equilibrium with the natural system. Sustainability is an integral basis for researchers, seeking to understand how socio-ecological systems adapt and transform to withstand environmental change.

The relevance of the work is determined by the fact that agricultural production occupies a significant part of the land and affects the climate in many regions. On the other hand, climate change affects the efficiency of agricultural production. From a social point of view, it should be noted that in some countries 80% of the population depends on farm work (Linesh Raja, Sonali Vyas, 2019). In environmental terms, it is important to address the many problems associated with agriculture: reducing biodiversity, fragmentation of natural ecosystems, pollution of surface water, land, changing the balance of nutrients.

The development of the world economy is accompanied by the exploitation of natural resources, the release of waste products into the environment and the partial deterioration of its quality (Land Degradation, 2015). Nature can compensate for lost properties with the help of a person, but in most cases there is no feedback in the Society-Nature system, and an artificial break in the links between the economy and irreversible changes in the agricultural systems occurs. A reorientation of agrotechnologies towards integration with ecology and consumption waste utilization that is painless for the environment is necessary.

Production efficiency depends on soil fertility, the level of agriculture, the economic system, the rationality of land use, etc. So, Russia possesses 55% of the area of the world chernozems, however, crop yields on them are 2-3 times lower than on poorer soils in Poland, Germany, and the Scandinavian countries. Russian scientists predict a shift of risky farming zones to the north by 200-350 km, and a corresponding increase in agricultural productivity with further climate warming. On the other hand, in traditionally agricultural regions of southern Russia, an increase of 1.8% in drought-prone areas, aridization of the forest-steppe and steppe zones, and the emergence of new diseases and plant pests are expected.

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