Issues of Digital Transformation of Biological Agriculture in the South-West of the Central Region of Russia

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Abstract. Intensification of world agriculture on the basis of scientific and technological achievements improves labour productivity and the living conditions of commodity producers. It is shown that in the agricultural sector alternative agriculture has been formed due to activation of biological processes. The directions of digital transformation of biological agriculture in the south-west of the Central region of the country are studied in the paper. It is established that smart farming technologies are currently being used in the Bryansk region; they are based on the application of geoinformation and satellite systems, as well as equipment monitoring systems. Digital solutions are being introduced in animal husbandry. The areas and specifics of consulting services to economic entities in order to develop biological agriculture are substantiated.

1 Introduction

Taking into consideration the forecasts of the United Nation for the growth of the world's population, the countries need to increase the level of food production by more than 70%. Providing economic and food security agriculture forms the agrifood market, labour and settlement potential. The scientific foundations of biological agriculture are profoundly developed, but their practical implementation is determined by nature and climate conditions, technological level of development, and general practice of crop rotations. Biologization is gradually being introduced in Russia, as it is one of the promising areas in the world agriculture due to its ensuring rational use of natural resources. In the context of digitalization of the agricultural sector, in order to support the sustainability of the agroecosystem it is advisable to introduce digital solutions. The application of biological farming systems requires specialists' technological discipline and expertise. It leads to an increase in the demand of business entities for consulting services. The Consulting 4.0 model allows agroconsultants together with the customers to analyse the internal and external environment and to determine the directions of development of organic farming.

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2 Materials and Methods

In the course of the research, the issues of digital transformation of biological agriculture are considered, and statistical data are used. On the basis of general scientific methods, the opportunities of using digital solutions in the process of agroecological resources reproduction are substantiated.

3 Results and Discussion

Giving a forecast for the prospects of the food market FoodNet the Agency for Strategic Initiatives notes that by 2035 rural producers will have occupied about 5% of the world market in such segments as "new sources of raw materials", "smart" agriculture, affordable organics and personalized nutrition. According to the latest data, the area of the world's organic farmland is about 75.0 million hectares. In 2020 the global organic food market reached 120.6 billion euros. Farmers in the leading countries use digital solutions for soil condition analysis, crop yield assessment, targeted fertilizer applications, etc. [1-2].

About 10% of the global funds of arable land are in Russia, with up to 40% located in the zone of risky farming. In recent years Russia has achieved high levels of food security in key areas. About 900 items of products are exported to more than 150 countries. Russia occupies the 18th place in the ranking of world food exporters. According to analysts, grain, vegetable oils, rapeseed predominate in exports. Importing will decrease. There are real opportunities for crop yields and animal productivity growth in the country. However, due to the low level of mechanization of agricultural work, shortage of fertilizers, a large number of farming enterprises with insufficient financial resources for agricultural innovations, a shortage of personnel, there is Russia's lagging behind the world economic leaders in terms of labour productivity and the pace of development of organic farming [3-4].

In some countries the intensification of agricultural production has led to environmental problems, mineralization losses of soil organics. The biologization of agriculture requiring rigorous technological discipline and competence of specialists, in its turn, is aimed at reproducing agroecological resources by activating biological processes. Biological agriculture actualizes differentiated tillage, compliance with the proper crop rotation, the use of organic fertilizers balanced with minerals. The main thing is to ensure a deficit-free balance of humus in the soil. Continuous monitoring of the nutrients balance in the soil-plant system is necessary [5-8].

The basic principles of biological agriculture include the rational human-centred use of nature according to its laws; reproduction of soil fertility; regular improvement of soil agrophysical and biological properties; effective management of interrelated processes in crop production and animal husbandry; surface soil treatment; replacement of mineral nitrogen fertilizers with biological nitrogen; high-quality clean production for dietary nutrition; use of energy-saving technologies; the content control of toxic elements in the ecosystem.

Crop rotation, as a key agronomic link, appears to be the fundamental basis of biological agriculture. When justifying rational crop rotation the issues of soil fertility reproduction, high-quality production, and environmental protection are primarily considered.

A differentiated tillage system, a system of fertilization, and a comprehensive plant protection system are implemented due to the selected crop rotation. Legume sideration and

application of rhizotorphin in crop rotation contribute to the optimal soil nitrogen regime. There is a need for new varieties of plants with a high nitrogen-fixing ability.

The Digital Agriculture platform supports the digitalization of the agrarian sector, the multifaceted interaction of its participants, including the provision of digital consulting services. The use of geoinformation systems allows creating a digital model of the agricultural landscape, obtaining the most important characteristics of the soil, planning and checking the quality of agrotechnical measures, monitoring the crops condition, predicting crop yields, and inspecting the machinery operation [9-12].

The use of multi-level remote sensing of the earth will serve to clarify information about the Earth's surface at three levels: space (using information from satellites), aviation (using information from unmanned aerial vehicles), surface (using spectral radiometric information, physico-chemical analysis of soils). Digitalization of the agrarian sector allows implementing rational use of natural resources, resource-saving agriculture, improvement of management efficiency, ensuring the sustainability of the organization development, involving workers with new specialization [3-4].

The researchers note that in recent years despite external and internal challenges in agriculture the necessary level of population consumption of the main types of products and their export is maintained both in Russia and in the Bryansk region. The Bryansk region is characterized by unique natural conditions for the cultivation of a number of field crops. Besides, its arable lands are sandy loam and low-yield with a fairly high acidity and the humus content not exceeding 3.5%. In general, natural factors contribute to the activation of biological processes and increase in soil fertility, and as a result, in crop yields. The region has made great strides in potato growing, significantly increased the production of grain crops, revived animal husbandry in agricultural holdings. The agrarian sector employs more than 650 organizations, more than 200 thousand personal subsidiary farms. In the structure of the rural population of the region more than 50% is the laboring population (Figure 1).

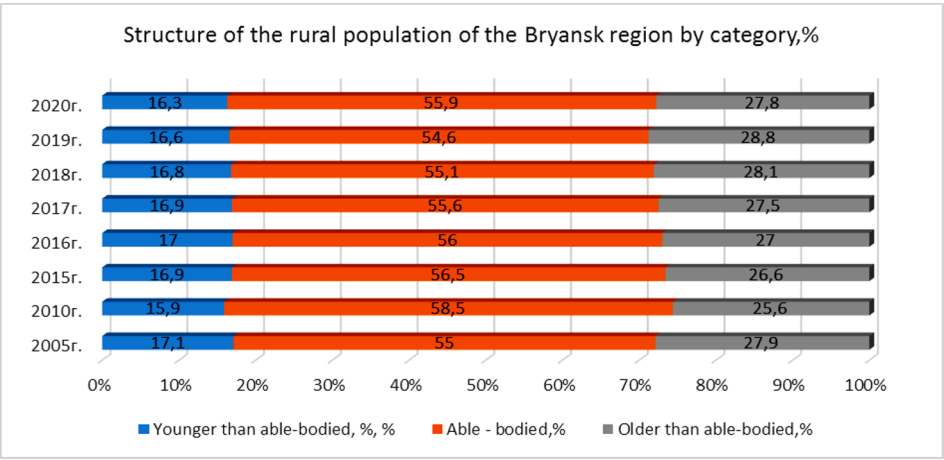

Fig. 1. The structure of the rural population of the Bryansk region by categories, % (compiled by the authors)

The contribution of agriculture to the gross regional product has increased to 30%.

In recent years the composition of output by categories of farms has changed (Figure 2).

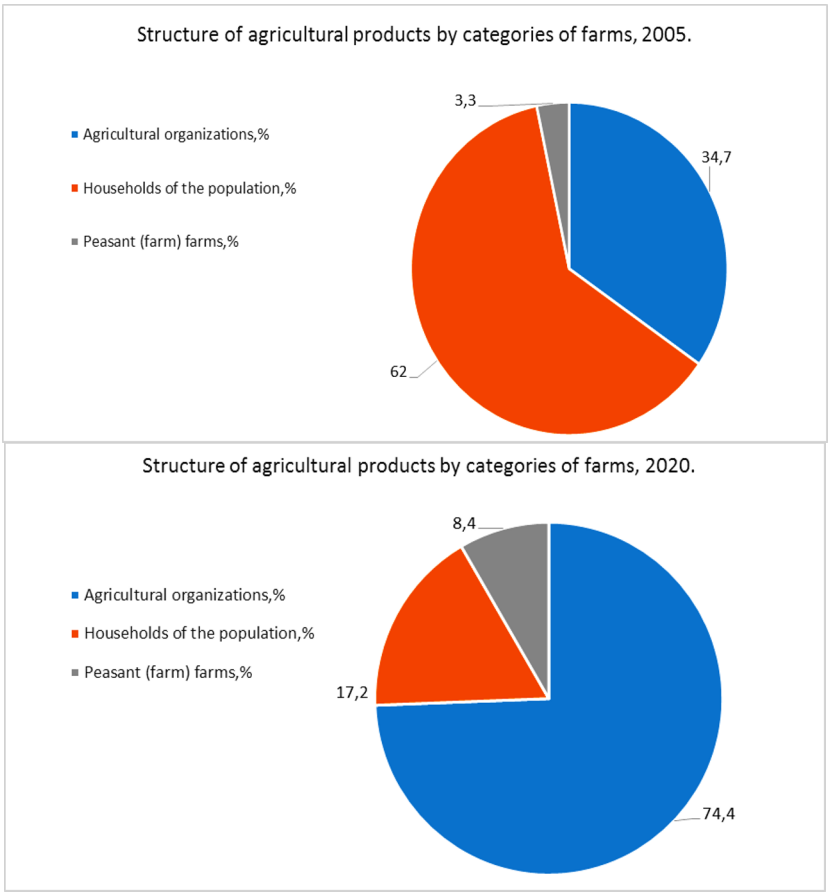

Fig. 2. Structure of agricultural products by categories of farms (compiled by the authors).

In the region precision farming technologies are being introduced; they are based on the use of geoinformation systems, satellite systems and machinery control systems, big data, and the Internet of Things. The research findings by the scientists of the Bryansk State Agrarian University are available to rural producers for practical use. To solve the problems of biologization of agriculture and to produce high-quality food commodities, it is necessary to provide farmers with access to digital platforms as services supporting the introduction of digital solutions for biologization of agriculture. Digitalization of biological agriculture due to the transfer of key business processes to the online environment launches the production of environmentally friendly products faster with their subsequent access to local and global markets. Computer modeling of solutions and application of predictive analytics will increase the efficiency of the production chain in the agrarian sector [4].

The production and application of knowledge is a key resource for the digital transformation of biological agriculture. The consulting in this field is specified by interrelated and interacting natural and biological factors. Crop production based on biologization necessitates the adjustment of professional training of workmen of market entities. Application of the acquired knowledge and practical skills will make it possible to preserve and economically use natural resources of the region. The organization forms of consulting services in agriculture are diverse (Figure 3).

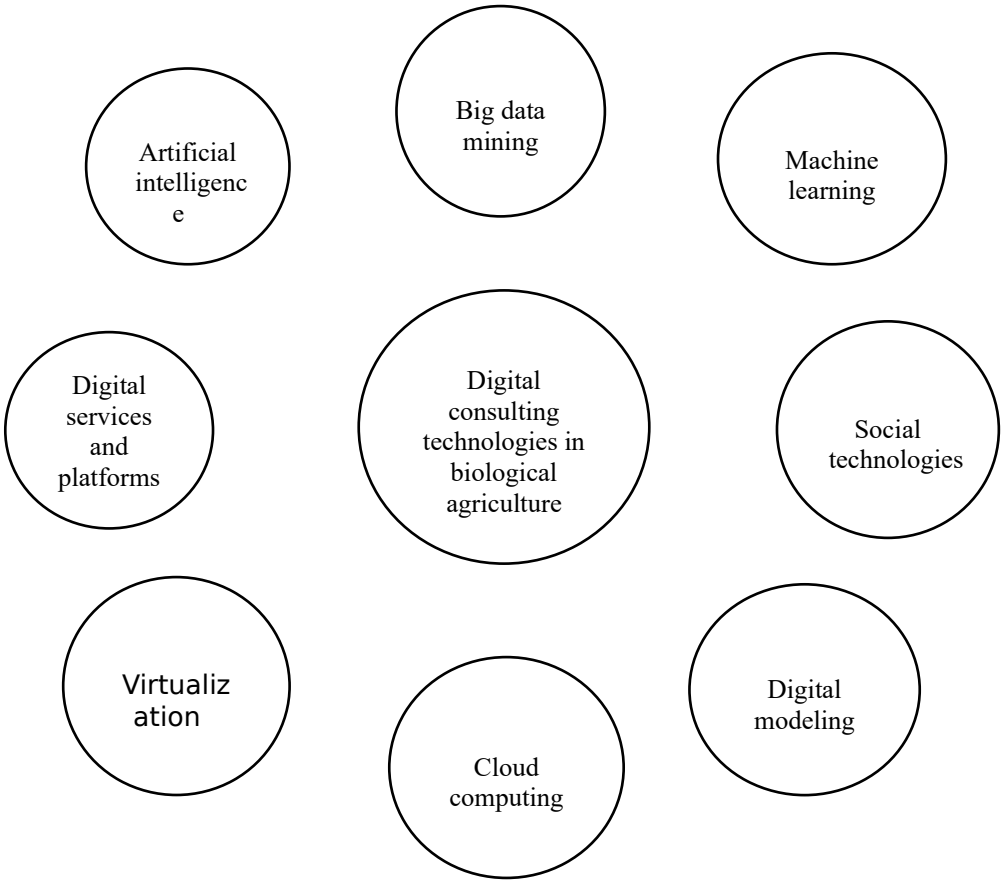

Fig. 3. Digital consulting technologies in biological agriculture (compiled by the authors)

The digital platform "Land of Knowledge" provides rural producers with access to the database of branch-wise knowledge. There is an opportunity to receive expert advice from leading universities and research institutes in a remote format. The Center of Competence of the Agroindustrial Complex of the Bryansk region offers information and consultation services to economic entities of the region. Rural producers have the opportunity to apply to the regional educational and methodological information and consultation center at the Bryansk State Agrarian University and to get support and advice on biological agriculture.

4 Conclusion

The application of digital technologies in biological agriculture creates agrotechnical and organizational prerequisites for the rise of labour productivity in the agricultural sector, ensuring rational use of natural resources, environmental protection, and an increase in the standard of living of the population.

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