Sustainable development of organic agriculture in the Baikal region, as a cross-border area

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Abstract. The article is devoted to the problem of sustainable development of organic agriculture in the Baikal region, in particular the transboundary territories of the Republic of Buryatia and Mongolia. The article presents a study into the structure of land use in border areas and an analysis of the applied farming systems. The prospects for organic agriculture in the republic are studied and a model of the market for organic products in the Baikal region is suggested.

1. Introduction

The Russian agriculture faces the challenges of not only agrarian and economic problems of increased production, identified in traditional farming systems, but also environmental problems related to environmental protection, environmental management, production of environmentally friendly products safe for health. In this regard, one of the most effective ways to improve the living standard in rural areas, sustainable development of rural areas, and increase the efficiency of production of ecological agricultural products is the development of organic (ecological) agriculture in Russia. Therefore, biologization and ecologization in the Baikal region is recognized as one of the main directions in the development of the zonal farming system and the sustainable development of organic agriculture in the Baikal region as a whole [1, 2].

It implies the adequate provision of the population with ecologically safe food while maximally saving renewable and non-renewable resources, unique natural complexes, and their biological diversity, designing agricultural landscapes to meet environmental requirements, creating an attractive rural environment, greening the processes of obtaining agricultural products that contribute to the successful development of rural areas the main zone of development of agricultural production, using the development of scientifically based methods for the selection of crops and varieties, crop rotation planning, taking into account the effectiveness of organic fertilizers, digital technologies for agro-ecological monitoring of lands, automated technologies in agricultural production [2].

Currently, the problem of sustainable development of organic agriculture in the Baikal region has not been studied enough. The analysis of approaches to solving this problem and the possibilities of implementation in the Baikal region are considered in this article.

2. The Object and Methodology of Research

The Baikal region is located in the southeastern territories of the Russian Federation, bordering Mongolia and China. It covers a total area of 570 thousand km². It includes the Lake of Baikal, a water protection zone, a catchment area, specially protected natural areas, as well as the adjacent territory
outside the catchment area), the so-called zone of atmospheric influence. The territory stretches from south-west to north-east along the eastern coast of Lake Baikal. The Republic of Buryatia occupies 73% of this territory. The southern border of Buryatia is the state border of the Russian Federation with Mongolia, in the east it borders on the Trans-Baikal Territory, in the west with the Irkutsk Region, in the extreme south-west with the Republic of Tyva, Russian Federation. The Republic of Buryatia has a common state border with Mongolia in five districts (Okinsky, Tunkinsky, Kyakhtinsky, Dzhidinsky, Zakamensky) [3].

The successful development and formation of cross-border territories is due to the need of establishing mutually beneficial economic ties and cooperation in the social, cultural, and economic spheres between the border areas of neighboring states.

The study of problems in the field of sustainable agriculture in the Baikal region and transboundary territories was carried out using general scientific methods and techniques: a scientific abstraction, analysis and synthesis, comparison, a structural-level approach. The theoretical and methodological basis of the study consisted of the works of national and foreign scientists on the problems of agricultural production of organic products, the development of land relations; scientific research and recommendations of the Russian Academy of Agricultural Sciences, laws of the Russian Federation, Decrees of the President and Decrees of the Government of the Russian Federation, normative legal acts of the subjects of the Russian Federation, Resolutions of the European Union on the development of ecological agriculture, and IFOAM standards.

3. Research Results and Discussion
The development of organic agriculture could be one of the promising areas for Russia as a whole and the cross-border areas of the Baikal region. The analysis shows that the border areas of Russia (Republic of Buryatia) and the adjacent aimaks of Mongolia are similar in the structure of land use, since most of the territory falls on agricultural land. Residential, industrial, and transport land use play a significant role in the Bulgan and Selenge aymaks (the cities of Erdenet, Darkhan and Sukhbaatar) and the adjacent Zakamensk and Kyakhtinsky districts of Buryatia (the cities of Zakamensk and Kyakhta) and constitute a small percentage of economically developed areas [4, 5].

When considering the structure of land use in the border areas, it can be concluded that agriculture dominates with the predominant industry, grazing, where ecological and geographical conditions for the development of traditional environmental management have a great influence.

In the famous research “Border and Transboundary Territories ...”, it is stated that “... The structure of agricultural land use in Buryatia is formed by two main types of activity: crop production and animal husbandry. In terms of production, livestock has always been the main branch of agriculture in Buryatia. The development of crop production in Buryatia is primarily subordinated to the interests of animal husbandry. This is especially clearly manifested in the ratio between domestic consumption and government purchases of grain in Buryatia in the gross harvest of grain crops, the crops which in different years occupied from 50 to 90% of the total area of arable land. Obviously, the overwhelming majority of crop production is consumed inside the farms producing these products. The structure of this consumption consists of seeds for crops in subsequent years and the use of crop production as feed for livestock, both public and private. With the almost unchanged area of crops in recent decades, the gross grain harvest varies greatly from year to year. The yield of grain crops in individual years may not exceed an average of 5 centuries per hectare, which causes instability of the forage base of animal husbandry in winter. This type of feeding makes livestock farming very risky (lack of food and, as a result worse productive indicators of livestock, its mortality) ...” [5].

The distribution of various types of natural forage lands in the border with Russia of the territory of Mongolia has a rather pronounced geographical pattern. Data on stocks, structure, and dynamics of vegetation indicate a strong decline in the productivity of vegetation in the latitudinal direction [6]. The productivity of natural forage lands in Mongolia depends on weather conditions by years, which is also observed in its regions bordering with Russia.
When analyzing the farming systems that were used in the territory of the republic, as well as in the border areas of Mongolia, it turned out that so far only production systems that mostly depended on the use of mineral fertilizers and pesticides were used in these areas and little or no attention was paid to alternative systems [7].

At the same time, there are prospects for organic agriculture in the territory of Buryatia and they are related to the fact that:

- The territory of the republic is located in the basin of Lake Baikal, which by the decision of UNESCO is classified as a world heritage site and requires a special regime of nature management;
- The climate is extreme continental, the soils are low productive, of light grain size distribution, and much of them are subject to erosion processes and degradation;
- Natural forage lands occupy a vast area, and livestock farming is the main branch of agriculture, production of livestock products in the private sector of the republic is increasing [8];
- Perhaps, the wide development of the tourist complex, which will require a significant amount of organic (environmentally friendly) food;
- The use of agrochemicals has decreased dramatically, mainly due to their high cost, as well as the use of organic fertilizers (manure) due to the elimination of livestock farms and the decline in stocks of previous years;
- There is a certain scientific background: various schemes of field and fodder crop rotations have been studied, the effectiveness of applying such legumes as clover and a manure in crop rotations has been considered; siders, composts, and vermicomposts have been tested in agriculture; a number of studies have been carried out on adaptive-landscape farming systems and nomadic livestock breeding;
- The republic does not have an acceptable strategy of integrating the experience of private, small landowners and large farms in the creation of sustainable livestock production;
- There is a market where organic (organic) food products in demand.

The above indicates that there are certain promises in the republic for the development of organic (ecological) farming systems and the prospects for obtaining organic products. In this regard, we have proposed a model of the market for organic agricultural products in the Baikal region (Fig. 1). Organic farming products in the Baikal region are fundamentally distinguished by a higher level of quality from those produced in the traditional way.

Figure 1. A market model of organic farming in the Baikal region.

Currently, Buryatia is considering ways of transition to organic agriculture. The prospects for organic farming in the Baikal region are being assessed. At the same time, the empty niche of the market for organic (environmentally friendly) products and the considerable land potential for the
Development of organic farming create all the necessary prerequisites for the formation and development of local agriculture oriented towards the production of organic products.

To ensure the sustainable development of organic agriculture in the territory, it is advisable to use a formalized procedure for analysis, modeling and forecasting, which includes the following steps (Fig. 2).

**Figure 2. Stages of sustainable development of organic agriculture.**

All stages describing the development of organic agriculture in the territory of the Baikal region include the processes of interaction between society and nature and describe the concept of ecological and economic system. This system is a contour formed by the two hierarchical substructures. On the one hand, the economic subsystem affects the environment. On the other hand, the ecological subsystem affects the economic subsystem. The composition of the economic subsystem primarily includes the following elements: agriculture, forestry, water management, environmental protection and quality control, and more.

Thus, sustainable organic farming in the Baikal region is a new stage in the relationship of the producer of agricultural products with the environment. Moreover, the transition to organic farming is a long-term process and the reorientation of agricultural production should be carried out in several directions, among which a special place should be given to personnel training.

### 4. Conclusions

The agriculture focused on the production of organic products refers to the parallel maintenance of the traditionally established industrial and production system, focused on the production of organic agricultural products, with a gradual increase in the share of the organic sector on the basis of rational, geographically adapted land use with minimum and reasonable use of chemicals in agricultural production. The introduction of methods for sustainable development of the region will allow the use of adapted and environmental technologies for growing high quality crop production in the Baikal region. It will also contribute to the expansion of theoretical knowledge in the field of organic agriculture. It is necessary to create a regional model of organic agriculture, which would promote the use of production technologies in the region built on a local closed cycle (including seeds, processing and consumption). Further, the use and expansion of organic agriculture will lead to the creation of a regional quality mark, the development of convenience stores, the development of social nutrition standards, and the adoption of a regional law on organic products. The creation of this model will favorably affect the development of cross-border areas of the Republic of Buryatia and contribute to
the establishment of mutually beneficial economic ties and cooperation with the border areas of neighboring states.

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