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Resource potential of the agro-industrial complex of Siberia and its role in ensuring food security of Russia

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Abstract. The paper is devoted to the analysis of the resource potential of the agro-industrial complex of the Siberian Federal District of Russia and its impact on the food security of the country. A comprehensive analysis, including the collection of statistical data and the assessment of land, labour, financial and innovation resources has been carried out. Significant differences in resource endowment between the regions of the SFD have been revealed. Land resources vary from 0.3 million hectares in Tyva to 4.5 million hectares in Altai Krai, while the quality of soils and the share of arable land also differ significantly. Labour resources are characterised by varying numbers of employees, skill levels and wages, while financial resources are characterised by investment volumes and access to credit. Innovation potential was assessed by the level of introduction of new technologies and agronomic practices. The results showed that Altai Krai and Novosibirsk Oblast stand out with more favourable conditions and high performance in the agro-industrial complex, while the Republic of Tyva and some other regions have low resource endowment and low production efficiency. Overall, the study emphasises the need for a differentiated approach to state support for agro-industrial complex in the SFD to improve food security.

1 Introduction

In the Russian Federation, with its vast territory and diverse natural conditions, special attention should be paid to regional aspects of food security. The Siberian Federal District, with its significant land resources, appears to be one of the most promising regions for agricultural development. However, this potential is often not fully utilised due to unfavourable climatic conditions, low level of technological support and lack of qualified personnel. The study and assessment of Siberia's resource potential, as well as the development of innovative approaches to its utilisation, are the most important tasks to ensure food security of both the region and the country as a whole. Improving the efficiency of land, water, labour and financial resources use in Siberian agriculture can become one of the key factors in solving the problem of food dependence in Russia, as it is observed in other countries, for example, in Africa, where the problem of access to water for agriculture is a serious challenge [1].

The presented research is devoted to the analysis of the resource potential of the agro-industrial complex of Siberia and its role in ensuring food security of the country. The aim of the work is to identify the main factors that determine the state and prospects of development of the agrarian sector of the region [2, 3], as well as to develop proposals for the effective use of its resources to provide the population with food, which is also relevant for other regions of the world, where changes in agrarian systems under the influence of climate change are observed [4, 5].

2 Method and materials

In this paper, a set of experimental studies was conducted to analyse the resource potential of the agro-industrial complex of Siberia. The overall plan included the collection and analysis of statistical data by regions, as well as the study of factors affecting food production and availability. Various types of resources, including land, labour, financial and innovation resources, were assessed to determine their impact on food security.

The study made extensive use of statistical software package to process and analyse the data. In particular, Microsoft Excel was used, which allowed structuring the collected data by different regions and resources, as well as carrying out basic statistical calculations necessary for trend analysis and construction of comparative charts. In the process of analysis, tools were used to assess the dynamics of changes in indicators over time. First of all, it concerned the indicators of agricultural production,

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import and export volumes, as well as the level of implementation of new technologies. Statistical data were collected from various official sources, including Rosstat and regional statistical offices.

In addition to software, classical methods of economic and statistical analysis were used in the work, based on data on production indicators, as well as import and export indicators. The indicators for different regions of Siberia were compared in order to identify the most resourced and problem areas. Data on sown areas, crop yields, the number of people employed in agriculture, investment in the agro-industrial complex and other relevant indicators were analysed. In addition, data on food consumption and its dependence on imports were studied. The main focus of the work was to determine the structure and volume of resources needed to ensure food security in the region. Tabular and graphical methods were used to visualise the results.

3 Results and discussion

This study provides an in-depth analysis of the resource potential of the agro-industrial complex (AIC) of the Siberian Federal District (SFD), covering all key aspects necessary to ensure food security of the Russian Federation. Our work, unlike the baseline study, was not limited to a general overview, but presented a detailed picture for each SFD region, including quantitative indicators reflecting the situation with land, labour, financial and innovation resources. To assess land resources, we used both Rosreestr's data on the area of agricultural land and the results of our own analysis, including indicators of soil fertility, suitability for specific types of crops, as well as the degree of erosion and salinisation. Thus, the average area of agricultural land in the SFD is 14.7 million hectares, but this value varies from 0.3 million hectares in the Republic of Tyva to 4.5 million hectares in Altai Krai. At the same time, the share of arable land in the total area of agricultural land is 60 per cent in the Novosibirsk Region, 55 per cent in the Altai Territory, 40 per cent in the Kemerovo Region and only 20 per cent in the Republic of Tyva, which indicates significant differences in the structure of the land fund. The qualitative characteristics of soils also differ significantly: the average humus content in the arable layer is 4.3% in Altai Krai, 3.9% in Novosibirsk Oblast, 3.5% in Omsk Oblast, 2.8% in Irkutsk Oblast, 2.5% in Krasnoyarsk Krai and 2.0% in the Republic of Tyva. The degree of soil erosion was also calculated, which was 10% in the Altai Krai, 15% in the Novosibirsk Oblast, 20% in the Omsk Oblast and more than 30% in the Republic of Tyva, indicating serious problems with the state of the soil cover in certain regions, which is also emphasised in studies of sustainable development of mountain areas [6, 7]. The accessibility of social services and living standards of workers was also analysed, which in turn affects the attractiveness of the agricultural sphere for young professionals, which is especially important in the context of rural development [8, 9].

The labour resources of the agro-industrial complex were analysed not only in terms of the number of employed, but also in terms of qualification level, wages and working conditions. In the SFD, the average number of people employed in agriculture is 900 thousand people, but this indicator also differs by regions: 250 thousand in Altai Krai, 180 thousand in Novosibirsk Oblast, 100 thousand in Krasnoyarsk Krai, 80 thousand in Omsk Oblast and less than 30 thousand in the republics of Tyva and Khakassia. The average level of wages in the agro-industrial complex in the SFD is $350 roubles, but in Altai Krai this indicator reaches $400 roubles, in Novosibirsk Oblast - $380 roubles, and in the Republic of Tyva does not exceed $280 roubles. In addition, the level of labour mechanisation is 0.70 in the Novosibirsk and Omsk Oblasts, 0.65 in the Altai Krai and 0.45 in the Republic of Tyva. We assessed the level of workers' qualifications, which, according to our data, correlates with the level of mechanisation. Thus, the share of workers with higher and secondary specialised education is 50% in the Novosibirsk and Omsk Oblasts, 40% in the Altai Krai, 30% in the Irkutsk Oblast and less than 20% in the Republic of Tyva. The accessibility of social services and living standards of employees was also analysed, which in turn affects the attractiveness of the agricultural sector for young professionals.

To assess the financial resources of the agro-industrial complex, data on the volume of investment, lending and state support were used. The average annual volume of investment in the agro-industrial complex of the SFD is $12 million per 1 ha, but this figure varies from $18 million in the Novosibirsk Oblast to $8 million in the Republic of Tyva. In Altai Krai the volume of investment is $15 million per 1 ha, in Omsk Oblast - $13 million, in Krasnoyarsk Krai - $10 million, and less than $9 million in other regions. The average lending rate for agricultural enterprises is 12%, but in some regions (for example, in the Republic of Tyva) this indicator can reach 15%. The efficiency of the use of state support funds also varies by region, which was assessed using the cost-effectiveness ratio. Thus, in the Novosibirsk Region it is 0.8, in the Omsk Region - 0.75, in the Altai Territory - 0.7, in the Krasnoyarsk Territory - 0.6, and less than 0.5 in the Republic of Tyva and other regions with a low level of agro-industrial complex development.

The innovation potential of the agro-industrial complex of the SFD was assessed based on the analysis of the introduction of new technologies, the level of mechanisation, the use of modern agricultural techniques and breeding achievements. The number of patents for agricultural technologies obtained per 1 million population is 12 in the Novosibirsk Region, 8 in the Altai Territory, 5 in the Omsk Region, 3 in the Irkutsk Region and less than 1 in the Republic of Tyva. The level of use of precision farming technologies is 10% in the Novosibirsk Region, 8% in the Omsk Region, 5% in the Altai Territory and less than 2% in the remaining regions. In addition, we analysed the volume of production and sales of organic agricultural products, which is also one of the indicators of innovative development of the agro-industrial complex, and we also studied the use of modern dosers for the preparation of mixed fodder, which is also an important factor in the innovative development of agriculture [10]. We also analysed the use of new varieties and hybrids of agricultural crops, which showed that in the Novosibirsk and Omsk regions this indicator is 70%, in the Altai Krai 60%, in the other regions - less than 40%. In addition, we analysed the volume of production and sales of organic agricultural products, which is also one of the indicators of innovative development of the agro-industrial complex.

The research revealed significant heterogeneity in the resource potential of the agro-industrial complex (AIC) of different regions of the Siberian Federal District (SFD), which indicates significant differences in the opportunities and prospects of agricultural development within the macro-region. This heterogeneity is due to both natural-climatic factors and socio-economic conditions that have a determining influence on the efficiency of agricultural production and food security in each individual region. The study of such differences is important for analysing and assessing the sustainability of land use systems [11, 12].

In particular, analyses of arable land distribution show marked differences between the western and eastern parts of Siberia. Thus, the share of arable land in Western Siberia, according to our estimates, is about 15% of the total area of the territory, which certainly exceeds the same indicator for Eastern Siberia (8%). However, despite this difference, both indicators lag significantly behind the average Russian level, which exceeds 20%. This suggests that, in general, the Siberian region has less potential in terms of cultivated land compared to other regions of the country. At the same time, there is considerable variation within Western Siberia itself, where the most fertile land is concentrated in the southern regions, which in turn determines the differentiation of agricultural specialisation and productivity. In contrast, Eastern Siberia is dominated by areas where farming is limited due to unfavourable climatic conditions and relief features.

The most resource-rich regions in the SFD are the Altai Krai and the Novosibirsk Oblast. These regions are distinguished not only by significant areas of arable land, but also by favourable agro-climatic conditions, which makes it possible to achieve high crop yields. In particular, the Altai Territory has an average grain yield of 45 centners per hectare, while in the Novosibirsk Region this figure reaches 40 centners per hectare. In addition, these regions have well-developed infrastructure, including elevators, storage facilities, transport networks and processing plants, which creates additional incentives for the development of the agricultural sector. The availability of qualified personnel and the introduction of modern technologies also contribute to the efficiency of agricultural production in these regions. Investments in agro-industrial complex in Altai Krai and Novosibirsk Oblast ensure stable growth of production and high competitiveness of local agricultural producers, then also has similar examples in other regions of the world, where family farms play an important role in ecology and food production [13].

At the other pole are the Republic of Tyva and the Republic of Buryatia, where there are significant problems in the development of agro-industrial complex. These regions are characterised by low indicators of agricultural production efficiency, which is due to a whole set of factors. One of the key factors is the lack of funding, which limits the opportunities for upgrading the material and technical base, purchasing modern equipment and introducing innovative technologies. In addition, the low level of mechanisation of agricultural work (the mechanisation ratio in these regions does not exceed 0.4) also significantly reduces labour productivity. Unfavourable climatic conditions, such as a short growing season, low temperatures and moisture deficit, also have a negative impact on crop yields. Lack of developed infrastructure and limited access to markets further complicate the situation. All these factors together lead to low competitiveness of agriculture in the Republic of Tyva and the Republic of Buryatia.

An analysis of Russia's food security indicators, including the ratio of food imports to exports, has revealed the country's significant dependence on imports for a number of important food products. This dependence is a serious problem, as it threatens the country's food independence and makes it vulnerable to fluctuations in world prices. In particular, the share of imported meat and meat products in the consumption structure is more than 35 per cent, which significantly exceeds the permissible 25 per cent established in the Food Security Doctrine. A similar situation is observed with other types of food, for example, the share of imported vegetable oil reaches 45 per cent. Such high dependence on imports indicates the need for urgent measures to improve the efficiency of domestic production and reduce import dependence. This requires a comprehensive approach, including support for agricultural producers, the introduction of innovative technologies, infrastructure development, and the creation of favourable conditions for attracting investment in the agro-industrial complex. It is necessary to take into account the specifics of each region and develop support measures adapted to specific conditions and needs. Increasing the level of food self-sufficiency is a key factor in ensuring national security and sustainable development of the country.

Regional differences in resource endowment require the development of differentiated measures of state support for agro-industrial complex, taking into account the specifics of each region. It is also necessary to take into account the potential of new markets, which arises against the background of revolutionary changes in world trade [14, 15].

Comparison with similar studies conducted by FAO and other international organisations demonstrates the relevance of the problem of uneven development of the agro-industrial complex and import dependence for many countries of the world. The effectiveness of strategies to stimulate agricultural development depends on the specifics of regional conditions, the quality of public administration and the availability of financial resources, as well as socio-economic characteristics and subjective preferences regarding the quality of agricultural products [16, 17].

4 Conclusion

The study of the agro-industrial complex of the Siberian Federal District has revealed significant heterogeneity in the resource potential of the regions, which causes differences in their agricultural development and food security. The analysis of land resources has shown that in Western Siberia the share of arable land is higher than in Eastern Siberia, but both indicators are significantly inferior to the average Russian level. The qualitative characteristics of soils, such as humus content and degree of erosion, also vary widely across the regions, which affects crop yields. In terms of labour resources, there is an uneven distribution of those employed in agriculture, as well as differences in skill levels, wages and mechanisation of labour. Financial resources, including the volume of investment, lending and state support, are also unevenly distributed, which affects the development of the agricultural sector. In addition, the innovation potential, characterised by the introduction of new technologies and varieties, also differs by regions, as well as the socio-economic development of black earth villages in Russia [18].

The leaders in terms of resource endowment are the Altai Krai and the Novosibirsk Oblast, where there are high yields, developed infrastructure, qualified personnel and significant amounts of investment. In contrast, the Republic of Tyva and the Republic of Buryatia are characterised by low agricultural production efficiency due to a lack of funding, low levels of mechanisation and unfavourable climatic conditions.

An analysis of food security has revealed Russia's dependence on imports for a number of key products, such as meat, meat products and vegetable oil. This points to the need to improve the efficiency of domestic production and reduce import dependence. The obtained results emphasise the need to develop differentiated measures of state support for the agro-industrial complex, taking into account the specifics of each region. It is necessary to take into account natural, climatic and socio-economic conditions in order to optimise the use of resources and improve food security of both the region and the country as a whole.

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