Statistical evaluation of the competitiveness of agriculture in the regions

Yu N Romantseva\textsuperscript{1,*} and E S Kolomeeva\textsuperscript{1}

\textsuperscript{1} Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, 49 Timiryazevskaya st., Moscow 127550, Russia

*E-mail: romantceva@rgau-msha.ru

Abstract. In the research work, the authors propose an approach to a comprehensive evaluation of agriculture competitiveness in the context of the regions of the Russian Federation based on the construction of a hierarchical multidimensional model. Current state of agriculture, its competitiveness, system of indicators of competitiveness of the agrarian sector, based on competitive advantages are assessed, choice of the most important indicators that formed the basis for regions division into three clusters differing in terms of agriculture functioning is justified. The analysis of clusters made it possible to identify directions for further development of groups of regions to achieve growth in agricultural production in accordance with the Forecast of socio-economic development of the Russian Federation for the period up to 2036 and the Strategy of spatial development of the Russian Federation for the period up to 2025.

1. Introduction

Currently, the dynamics of agricultural development in general is evaluated positively not only by the scientific community [1], [2], [3], but also by the country's leadership [4]. However, there is also a tendency to increase differentiation in the pace and level of agricultural sector development, increasing the gap in the technical and technological level, the readiness of farmers to digital transformation of agribusiness [5], the economic efficiency of agricultural producers, the structure of production by farms categories. All this has an impact not only on the competitiveness of the agricultural sector in the region, but also on the country's position in world markets.

In accordance with the Forecast of socio-economic development of the Russian Federation for the period up to 2036, for the progressive development of the agro-industrial complex, the most important goal of state support measures implementation is to increase the competitiveness of Russian agricultural products in the domestic and foreign markets [6].

It is assumed that by 2036, the growth of agricultural production will be 55.0% compared to 2018, food production will grow by 2.1 times. The growth of agricultural production is currently the main criterion of industry development. This task is all the more urgent in the framework of the export-oriented policy in agriculture implemented in our country. Sufficient in-home provision of domestic food contributes to the development of the country's export potential.

Under the region's competitiveness in work we understand the region's competitive advantages in the markets due to natural resources created by the region's economic, innovative, environmental, and social resources; its ability to create and use competitive advantages to hold or improve its position in the markets of the competing regions as well as the ability of individual producers to win the
competitors (on domestic and foreign markets), allowing to support the main goal – improving the efficiency of production and growth in the region's population well-being [7]. The competitiveness of agriculture in the region is usually understood as the ability of the industry to increase the volume of added value based on the growth in the efficiency of the use of production factors (land, labor resources, fixed and circulating assets), to increase the production of agricultural products that meet the requirements of world and domestic markets, and to create conditions for the growth of income of enterprises in the industry [8].

2. Materials and methods of research
The set of regions of the Russian Federation is considered as an object for the analysis of competitiveness. The choice of the object is caused by the availability of statistical information, as well as the fact that the subject of the Russian Federation is an integral socio-economic system, the development of which is influenced by a complex of both external and internal factors.

The analysis of the competitiveness of the agricultural sector was carried out in stages:
- formation of a database of indicators provided by official statistics for the regions of the Russian Federation;
- classification of the system of agricultural competitiveness indicators in terms of competitive advantages of regions;
- selection of main indicators for clustering the subjects of the Russian Federation, their standardization;
- identification of groups of regions by the competitiveness level of the agricultural sector based on cluster analysis;
- comprehensive characteristics of groups to determine the directions of their development and increase their competitive advantages.

The peculiarity of the presented methodology is the use of a significant set of indicators, which allows a comprehensive assessment of the agriculture competitiveness. And the use of open data from the Rosstat will allow to analyze the differentiation of regions for other periods of time and in different sections.

The above indicators are processed using the STATISTICA 6.0 software package.

3. Results and discussion
Currently, agriculture in Russia is one of the few sectors of the economy that shows a tendency to grow even in an unstable economic situation. If the real volume of GDP over the past 5 years increased by 2.4 p.p. after the crisis in 2014, then this period for agriculture, taking into account significant state support, was generally favorable: for 2014-2018. The GVA of agriculture, forestry, hunting, fishing and fish farming increased by 14.0%. However, the impact on economic growth was insignificant due to the low weight of the industry in the GDP structure (3.1%).

At the same time, it is worth emphasizing that the state of the agricultural sector does not allow to speak about the competitiveness of domestic agriculture at the world level. Low technical, technological and digital level of development, relatively weak state support, weak investment attractiveness, low labor productivity, significant share of small-scale forms of entrepreneurship (households and farm sector), high production costs, continuing price disparity, monopoly of the first and third spheres of the agro-industrial complex - all this affects the competitiveness of agricultural producers, hinders the development of the industry and does not allow to fully realize the huge resource potential.

The question of the need to evaluate the level of competitiveness of regions and identify factors affecting the development of the subjects of the Russian Federation arises due to the strong differentiation of regions in terms of agricultural development, differences in soil-climatic and economic conditions of management on the territory of the Russian Federation [9, 10, 11].

The choice and formulation of indicators that characterize the level of regional competitiveness are determined by the main criterion for the growth of agricultural competitiveness - the achievement of
forecast values of gross output. This, in turn, should lead to meeting the needs of the population in food products, increasing export potential, increasing agricultural producers’ income and rural areas development.

To evaluate the competitiveness of regions, the authors identified the following groups of indicators that characterize the competitive advantages of agriculture:

1. Conditions external to agricultural production;
2. Internal conditions of agricultural production management;
3. Efficiency of using the agriculture economic potential (Table 1).

| Group of indicators | Statistical indicators                                                                 | Characteristics of indicator in terms of competitive advantages                                                                                                                                 |
|---------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| External conditions of agricultural production management | Potential climate productivity with normal humidification and the most complete use of thermal resources, point | Conditions of agricultural production (soil and climate)                                                                                       |
|                     | Cadastral land value, rub per 1 ha                                                      | Soil quality and land productivity as the main factor of production                                                                           |
|                     | Amount of state support funds per 100 hectares of farmland, thousand rubles            | Level of state support                                                                                                                       |
|                     | Consumer expenses on food products per capita, rubles                                  | Population consumer demand                                                                                                                   |
| Internal conditions of agricultural production management | Share of GVA of agriculture, forestry, hunting, fishing and fish farming in the GRP of the region, % | Contribution of the industry to the formation of the gross regional product                                                                  |
|                     | Share of the agriculture fixed assets value in the total fixed assets value, %          | Industry contribution to the fixed assets value                                                                                               |
|                     | Share of agricultural enterprises in the production of agricultural products, %        | Institutional structure of agricultural producers, placement of production by farm category                                                  |
|                     | Amount of investment per 100 hectares of farmland, thousand rubles                     | Level of intensification                                                                                                                      |
|                     | Cost of fixed assets of agriculture, forestry, hunting, fishing and fish farming per 100 hectares of farmland, million rubles | Provision with fixed assets                                                                                                                    |
|                     | Share of wages in agriculture to the average wage in the region                        | Development of rural areas                                                                                                                     |
| Efficiency of using the agriculture economic potential | Gross agricultural output per 100 ha of farmland, thousand rubles                       | Efficient land resources use                                                                                                                   |
|                     | GVA of agriculture, forestry, hunting, fishing and fish farming per 100 hectares of farmland, thousand rubles | Agriculture yield                                                                                                                             |
|                     | Gross output (GVA) for 1 ruble of investment, rubles                                    | Return on investment characterizes the investment attractiveness of the region                                                             |
|                     | Production of agricultural products per capita, thousand rubles                        | Food security of the region                                                                                                                   |
|                     | Share of unprofitable agricultural organizations, %                                    | Income level of agricultural producers                                                                                                        |
|                     | GVA of agriculture and forestry.... per 100 ha of farmland                             | Assessment of the possibility of introducing scientific and technical innovations                                                               |
|                     | Coefficient of fixed assets renewal                                                   | Degree of physical and moral depreciation of fixed assets                                                                                     |
|                     | Cost of fixed assets per 100 ha of farmland, thousands                                | Provision with fixed assets                                                                                                                   |
|                     | Investments in fixed assets per 1 ruble of the cost of fixed assets, rubles             | Investment level                                                                                                                             |

Based on the expert evaluation, the most important indicators presented in the table were included in the econometric model for further analysis of agriculture competitiveness in the regions.

The most significant changes in the spatial organization of the economy are the concentration of agricultural production in areas with the most favorable agro-climatic and soil conditions and an
advantageous position relative to capacious consumer markets \[12\]. Therefore, we considered the indicator "Potential productivity with normal humidification and the most complete use of thermal resources", which characterizes the soil and climatic conditions of management, as a competitive advantage in the production of agricultural products as the most important indicator of competitiveness.

The second most important indicator of competitiveness was the indicator "The share of GVA of agriculture, forestry, hunting, fishing and fish farming in the GRP of the region", which allows to assess the contribution of the agricultural sector to the development of the region's economy, as well as to compare the industry with other sectors of the region.

Indisputable indicators that characterize the development of any industry are indicators of the efficiency of available resources use. In agriculture, this is land as the main factor of production, and the "GVA of agriculture, forestry, hunting, fishing and fish farming per 100 hectares of farmland" allows to assess the intra-industry competitive advantage of the object. A higher yield per hectare of land contributes in one way or another to higher productivity and lower overall costs, which ultimately reduces price growth and increases the competitiveness of the industry \[13\].

The indicator that characterizes on the one hand sustainable agricultural production, and on the other hand the provision of food to the population of the region – "Gross agricultural output per capita" was also considered in the model as competitiveness indicator.

The indicator that forms the level of domestic agriculture competitiveness and the investment climate of the industry - "Investment per 100 hectares of farmland" is also considered as an element of the region competitiveness, since it is the most important factor in the sustainable and effective development of the industry. In the whole country, the share of investments in agriculture, hunting and forestry in their total volume in the economy is 3.6%, which is significantly lower than the contribution of the industry to the GVA.

Also in the cluster analysis, the indicator "Amount of state support funds per 100 hectares of farmland" was considered. The choice of this indicator is due to the need for state regulation of agricultural production in regions for which the development of rural areas is a priority.

All indicators of the region's competitiveness were standardized to bring them to the same units of measurement.

As a result of the cluster analysis using the Ward method, three groups of regions were identified (Figure 1). As can be seen, the subjects of the Russian Federation are distributed relatively evenly in number and compactly over the territory.
**Figure 1.** Dendrogram of cluster analysis of regions by the level of agricultural competitiveness.

To find out the reasons for this distribution, first, it is necessary to consider the economic conditions for groups of regions (Table 2). Thus, the indicators of the regions of the first cluster as a whole are higher than those of the second and even more so of the third.

| Indicators | Clusters | Average on total | Cluster III to I ratio, % |
|------------|----------|------------------|--------------------------|
|            | I (non-agricultural type) | II (mixed type) | III (agricultural type) |                      |
| Number of subjects of the Russian Federation | 22 | 30 | 25 |                      |
| GRP per capita, thousand rubles | 638 | 364 | 289 | 419 | 45.3 |
| Investments in fixed assets per capita, thousand rubles | 170.6 | 87.3 | 73.4 | 106. | 43.0 |
| Population employment level, % | 48.3 | 46.6 | 44.3 | 46.4 | 91.6 |
| Per capita income, thousand rubles per month | 31.1 | 29.6 | 24.7 | 28.6 | 79.3 |
| Share of rural population in total population, % | 22.2 | 28.7 | 36.5 | 29.0 | 164. |
| Potential climate productivity, point | 94 | 134 | 119 | 117 | 126. 3 |
| Values of sub-indices of the Digital Russia Index | 59.6 | 60.7 | 54.5 | 58.3 | 91.4 |

Source: calculated by the authors according to the Rosstat and [[14]]

The first cluster is characterized by an industrial type of production. The regions represented here have a developed economy with a high digital potential (the value of the Digital Russia sub-index is 59.6%), the level of investment and employment, which exceed the average in Russia by 60.3 and 4.5%, respectively. These are industrial-type regions, with a share of the rural population of 22.2% and GRP per capita above the average by 52.3%.

In contrast to the first cluster, the regions of the third group have a pronounced agricultural orientation: the share of the rural population is 36.5%, which is a quarter higher than in the country as a whole. The level of economic development of the regions is low: GRP per capita is slightly above two thirds of the average in the country, investment prospects are weak, which is reflected in average incomes.

The second cluster occupies an intermediate position in most indicators, but it should be noted that its soil and climatic characteristics are the highest in the aggregate and exceed the average level by 14.5%. Which, together with the average indicators of the state of the socio-economic sphere, allow to speak about the high potential for agriculture development.

For further clusters evaluation from the perspective of their potential for increasing agricultural production, we will consider the system of indicators of the competitiveness of the agricultural sector by cluster (Table 3).

| Indicators | Clusters | Average on total | Cluster III to I ratio, % |
|------------|----------|------------------|--------------------------|
|            | I (non-agricultural type) | II (mixed type) | III (agricultural type) |                      |
| Share of GVA of agriculture, forestry, hunting, fishing and fish farming in the GRP of the region, % | 2.8 | 6.2 | 15.1 | 6.5 | 540.5 |
| Share of agricultural enterprises in the production of agricultural products, % | 49.7 | 56.9 | 58.2 | 56.5 | 117.1 |
| Production of agricultural products per capita, thousand rubles | 22.7 | 35.5 | 71.1 | 41.8 | 312.6 |
|                                | 1st cluster | 2nd cluster | 3rd cluster | Mixed type |
|--------------------------------|-------------|-------------|-------------|------------|
| Amount of state support funds per 100 hectares of farmland, thousand rubles | 51.7        | 96.4        | 72.9        | 74.3       | 140.9      |
| Amount of investment per 100 hectares of farmland, thousand rubles        | 124         | 288         | 221         | 215        | 178.0      |
| GVA of agriculture, forestry, hunting, fishing and fish farming per 1 ruble of investment, rubles | 8.59        | 6.75        | 7.31        | 7.28       | 85.1       |
| Gross agricultural output per 100 ha of farmland, thousand rubles         | 1345        | 3034        | 2624        | 2405       | 195.0      |
| GVA of agriculture, forestry, hunting, fishing and fish farming per 100 hectares of farmland, thousand rubles | 1065        | 1943        | 1615        | 1567       | 151.6      |
| Cost of fixed assets of agriculture per 100 hectares of farmland, thousand rubles | 725         | 1746        | 1519        | 1375       | 209.5      |

Source: calculated by the authors according to the Rosstat

Analysis of the table data showed that for the regions of the first cluster, the agricultural sector plays an insignificant role in the economy: the share of GVA of agriculture, forestry, hunting, fishing and fish farming in GRP is 2.8%, and the gross output per capita is almost 2 times lower than the national average with low efficiency of farmland use. The low investment attractiveness of the sphere is also reflected in the level of regional competitiveness. The high rate of return on investment, characterized by the GVA of agriculture, forestry, hunting, fishing and fish farming per 1 ruble of investment is due to the high share of non-commodity households that produce more than half of agricultural products.

In the regions of the third cluster, the GVA of agriculture, forestry, hunting, fishing and fish farming produce more than 15% of GRP with a high level of contribution from agricultural organizations (58.2%). All the main economic indicators for the group under consideration are at an average level, including the amount of state support and investment. An increase in these indicators would lead to an increase in gross output, and given the high proportion of the rural population, to further development of rural areas.

The regions of mixed type of farming, in spite of the minor contribution of the agrarian sector in the formation of GVA (6.2 %) and the provision of gross production (35.5 thousand rubles per capita, which is 15.1% below the average for the aggregate), are characterized by both the highest indicators of investments and state support funds (288 and 96.4 thousand rubles, respectively), and the gross output and GVA per unit area. These are regions that conduct high-intensity production with high availability of fixed assets.

4. Conclusions
Thus, the increase in the competitiveness of agriculture in individual regions leads to the development of agriculture and the competitiveness of the agricultural sector of the country as a whole, ensures the development of rural areas, creates a multiplier effect for the development of related industries.

As a result of the study, a methodology for determination of the agriculture competitiveness in Russian regions was developed and tested, based on the system of indicators proposed by the authors.

The methodology will make it possible to develop a set of measures in the regions that will promote the growth of the competitiveness of agriculture, increase the efficiency of the agricultural sector of the economy; will stimulate the development of measures to ensure sustainable development of the agri-food market in the regions of Russia, ultimately, will be aimed at the development of the most effective ways of conducting competition policy in the agro-industrial complex and minimization of possible risks.

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