Improvement of the methodological approaches to the evaluation of the agro-industrial clusters development potential in the regional economy

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Abstract. The article is devoted to the improvement of methods for the evaluation of the cluster potential of agro-industrial sectors. The theoretical basis for the research was the results of the analysis of the accumulated foreign experience and current Russian practice regarding the assessment of the cluster potential of the regions territories. Focusing on the studied approaches, taking into account the identified advantages and disadvantages, the authors formed a methodology for assessing the cluster potential of the territory, which allows not only to identify priority cluster groups in the context of the region, but also in the context of macro-regions of the subjects of the Russian Federation. Approbation of the proposed method was carried out on the example of the Krasnoyarsk territory macro-regions in order to identify a potential cluster of "Agriculture" group. The results of the research can be used by regional and Federal authorities for adjusting the existing legal and strategic documents in terms of the state support measures aspects for the industrial sector, including the agro-industrial complex.

1. Introduction
The economics of Russia and the constituent entities of the Russian Federation, currently struggling due to the results of the global economic crisis, has faced with new unfavorable factors connected with sanctions of the Western countries that have taken the form of the closed foreign borrowings and cuts of inward investments.

In spite of the fact that Russia has got a great number of federal and regional strategic agricultural development documents, focused on the stimulation of competitive ability and an increasing topicality for the population, there are no large-scale transformations in the agribusiness in the dynamics of the product quality growth and thinking stereotypization related to running business in the agricultural sector [1].

Doubtless, these circumstances predetermine the need of formulating the mechanisms for modernizing regional policies that ensure not only short-term, but also medium- and long-term sustainability of their development.

The cluster approach use is currently getting one of the key areas of regional policy. Creating a regional cluster structure affects many aspects: increasing the competitiveness of the region; growth in business activity; increase of investment attractiveness and, as a result, investment growth; infrastructure development, increase in gross regional product, as well as the regional budget replenishment [2-5].
Consequently, the need for the formation of integrated production groups and technologically connected chains uniting various business entities in order to achieve a specific economic result in the range of one administrative territory is obvious.

The foregoing problems of modern agribusiness determine the topicality of this article. In addition, the research problems are caused by insufficiently elaborated methodological aspects on the issues of study the interaction of cluster formation in the regional agro-industrial complex. Due to this fact the aim of the research is to form the evaluation methodology of the cluster cooperation in the agricultural sector, taking into account the foreign experience and domestic practice.

2. Methods

The study of the theoretical issues of the regional economical clustering, cluster identification, cluster policies and assessing the cluster development potential has been carried out by a great number of foreign and Russian authors. The analysis of foreign experience indicates [3,4,5,6,7,8] that for cluster identification the following methods are often used: identifying groups of related industries using specialized input-output tables (interindustry balance) and identifying significant cluster groups.

Russian researchers are also focused on these methodological approaches with the difference that the set of indicators within the range of the author’s methods can vary.

In order to identify the peculiarities inherent to methodological approaches to the evaluation of the cluster cooperation in the agricultural sector of the regional economy, as well as the features of the formation of cluster development evaluation algorithms, a comparative analysis of the structural elements of the author’s identification cluster potential methods [6-13] according to a specific set of criteria has been conducted.

The research results, presented in accordance with table 1, allow us to formulate the following conclusions. Almost all approaches provide for the calculation of three indicators (significance, coherence and effectiveness). The differences are in the procedure of calculating these indicators. For example, the indicator of significance is calculated more on the basis of indicator’s localization and to a less extent through the coefficient of per head production. While calculating the coherent indicator, an approach based on determining the number of cluster group intersections by the volume of shipped products, as well as the calculation of the CAGR indicator (proposed by M. Porter [8]), are not used.

The determination of the efficiency indicator takes into account the «Average monthly salary of employees», «Profit» and «Investment in fixed assets» for the cluster group. Few authors use the aggregated method, which involves determining the aggregate indicator of the development potential of cluster groups.

Thus, according to the authors, while assessing the potential of cluster development of territories, it is advisable to rely on the calculation of three indicators: 1) a significant indicator (formed on the basis of the localization indicator, specialization and per head production rate); 2) the coherent indicator (formed on the basis of the number of cluster group intersections by the number of employed people in the industry, as well as cluster group intersections by the volume of shipped products shipped; the compound annual growth rate (CAGR) is taken into account); the efficiency indicator (formed taking into account the «Average monthly salary of employees», «Profit» and «Investment in fixed assets» for the cluster group).
Table 1. Comparative analysis of the methodological approaches to the evaluation of the cluster development potential of territories (compiled by the authors).

| Authors of the methodology | The definition of the measure of significant indicator formed on the basis of the localization indicator | The definition of the measure of significant indicator formed on the basis of specialization indicator | The definition of the measure of significant indicator formed on the basis of the number of cluster group intersections by the number of employed people in the industry | The definition of the measure of the coherent indicator formed on the basis of the number of cluster group intersections by the volume of shipped products shipped | The compound annual growth rate (CAGR) is taken into account | The efficiency indicator formed taking into account «Average monthly salary of employees» for the cluster group | The efficiency indicator formed taking into account «Profit» for the cluster group | The efficiency indicator formed taking into account «Investment in fixed assets» for the cluster group | Definition of indicators in dynamics | Formation of the aggregate indicator of the development potential of cluster groups | The analysis of indicators, without the formation of the aggregate value |
|-----------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| T. P. Danko, E. S. Kutsenko, A. N. Kiselyov [9,10] | + | + | - | + | - | + | + | + | + | + | + | + |
| V. V. Pechatkin [11] | + | - | - | - | - | - | + | + | + | - | - | + |
| И.Н. Поспелова [12] | + | + | - | - | - | - | - | - | + | - | + | + |
| Y. P. Bachinina [13] | + | - | + | - | - | + | - | - | + | - | + | + |
| Perényi Áron [6] | - | - | - | - | - | - | + | + | + | - | + | + |
| Huseynova K. [7] | - | - | - | - | - | + | + | + | + | - | + | + |
| М. Porter [8] | + | + | - | + | - | + | + | + | + | - | + | + |

In the evaluation process, it is necessary to calculate indicators in dynamics to obtain more objective results. Consequently, according to the authors, it is advisable to end up the methodological assessment toolkit with the formation of an aggregate indicator of the cluster group development potential.

3. Results

As a result of the theoretical analysis of methodological approaches, three main indicators are identified that are necessary for a comprehensive assessment of the cluster development potential of the region: 1) significant indicator; 2) coherent indicator; 3) efficiency indicator. The calculation of these indicators is carried out in a certain sequence with the use of the appropriate methodological and mathematical tool (figure 1). Testing of the proposed methodology was carried out on the example of the Krasnoyarsk Territory in the context of its macro-regions with a view to assessing the cluster potential in the agro-industrial complex, estimated period 2016-2018.

As part of the first stage, the authors evaluated the most promising areas of development of Krasnoyarsk Territory, taking into account the specific activities of the region, the features of its development and possible future prospects. The process of determining the cluster potential begins with the determination of the most capacious indicator – a significant indicator of cluster potential. To
determine this, six key indicators have been calculated, which are subsequently aggregated into a significance indicator: (1) the localization coefficient \( LI \); (2) the coefficient of specialization \( CS \); (3) the size of the \( S \) and (4) focus \( F \), determined by the number of employed people in the industry; (5) the size of the dimensions \( S \) and (6) of the focus \( F \), determined by the volume of shipped products.

According to the results of the obtained value of the significant indicator, depending on the number of employees and the volume of shipped products, Section A «Agriculture, forestry, hunting, fishing and fish farming» is the most attractive.

To confirm the obtained results, it is necessary to calculate the coherence indicator and the efficiency indicator. Following the proposed calculation methodology (figure 1), the coherent indicator is determined on the basis of the number of intersections of cluster groups by the number of people employed and the volume of shipped products. The construction of areas of cluster potential was based on the following indicators (table 2): rate \( S \) by the number of employed people in the industry; average number of employed people in the industry; average rate \( S \) by volume of shipped products; compound annual growth rate (CAGR).

**Table 2.** The coherent indicator for the cluster group "Agriculture" in the Krasnoyarsk Territory (calculated by the authors according to Rosstat).

| Activity status | Average rate \( S \) by the number of employed people in the industry | Average number of employed people in the industry | CAGR | Average rate \( S \) of volume of shipped products | CAGR | Coherent indicator |
|-----------------|-------------------------------------------------|---------------------------------|------|---------------------------------|------|-------------------|
| Section A: Agriculture | 0.006774756 | 34514,33333 | 0.13 | 0.0445956 | 0.0527 | 3 |
The obtained results of calculating the coherent indicator confirm the earlier conclusion about the high clustering potential in the agricultural sectors of Krasnoyarsk Territory.

As a result, the efficiency indicator is correct, based on determining the rank of the cluster group according to the indicators «Average monthly salary of employees», «Profit», «Investments in fixed assets». The combined potential of cluster groups in the Krasnoyarsk Territory is the aggregated value of all three indicators. In accordance with the calculations of the assessment of the cluster potential of the whole area of the Krasnoyarsk Territory, it can be concluded that Section A «Agriculture, Forestry, Hunting, Fishing, and Fish Farming» has a corresponding high development potential.

Using the algorithm developed by the authors (figure 1), as part of the research, an assessment of the cluster potential in the context of the macro-regions of Krasnoyarsk Territory (East, West, Angara, North, Central, and South) was carried out. On the result of calculations, the prospects of the agro-industrial cluster structure organization in the Western, Eastern and Southern macro-regions of Krasnoyarsk Territory have been revealed.

4. Conclusion
To sum up, it can be stated that foreign experience in assessing cluster potential is largely applicable to Russian realities while conducting the research at the regional level. Appropriately state statistics allow us to identify promising areas for the development of clusters in the economy of the region, as well as draw conclusions about their status, development trends and the necessary support areas.

Thus, the methodological tools proposed in the research, providing continuous improvement and adjustment depending on strategic priorities and regional interests, can serve as the basis for decision-making on the development and implementation of the cluster policy for Russian regions.

Improving the tools and methods of the state policy in the region in the field of food security and investment development through the usage of cluster interaction mechanisms in the agricultural sector will increase the level of food security and food independence of the region, as well as the level of investment stability and regional social-economic development.

Acknowledgements
The presented research was funded by Krasnoyarsk Regional Fund of Science in the framework of the scientific project: «Methodological approaches to the formation of a new system for innovative investment sustainability for resource-type regions based on elaboration of the cluster policy mechanisms (as exemplified by the Krasnoyarsk territory).

References
[1] I R Ruiga et al 2019 Food security of the Arctic zone regions in the Russian Federation: formation of methodological principles and performance indicators IOP Conf. Ser.: Earth Environ. Sci. 315 022073
[2] Ruiga I, Vasilyev E, Raznova N, Burmenko R and Burmenko T. 2018 Evaluation of the impact of cluster structures on the economy of the region 5th International Multidisciplinary Scientific Conference on SOCIAL Sciences & Arts SGEM 2018
[3] Terstriep J et al 2015 Innovation, knowledge and relations – on the role of clusters for firms’ innovativeness European Planning Studies 2167-99
[4] Christopher S F 2013 The Effects of Industrial Clusters on the Poverty Rate Economic
Geography 129-54

[5] Rune Njøs 2015 Cluster policy and regional development: scale, scope and renewal, Regional Studies Regional Science 146-69
[6] Perényi A 2016 Diagnosing cluster competitiveness using firm-level data in the profit-growth nexus framework Acta Oeconomica 439-63
[7] Khatira H 2016 Quantitative and qualitative assessment of the region's competitiveness International Journal of Scientific & Engineering Research 736-8
[8] Porter M 2001 Competition (M.: Publishing house "Williams")
[9] Danko T P 2010 Basic approaches to identifying clusters in the economy of the region Economic problems of regions and industry complexes 248-54
[10] Kiselev A N 2011 Determination of priority directions for the formation of clusters of small and medium-sized enterprises on the example of Moscow Network business and cluster technologies 279-302
[11] Pechatkin V V 2010 Methods of assessment and analysis of the potential of clustering of the economy of regions Economic analysis: theory and practice 42-8
[12] Pospelova I N 2016 Assessment of the clustering potential of manufacturing industries in the Altai territory Bulletin of the Altai state agrarian University 184-8
[13] Bachinina Y P 2010 Clustering as an opportunity to ensure the competitiveness of the oil and gas region (Tyumen: TSOGU) p 120