The model of food security of the Volga federal district regions

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Abstract. The global economic crisis dictates new conditions for the existence of the country's economy and its regions. The existence and independence of countries and regions is ensured by the interaction of various kinds of indicators that make up the food security system. Food security of both the country and the individual region is a fundamental strategy for the country's economy development. Ensuring food security is the development strategy of any country. The assessment of the food security of the regions makes it possible to determine their independence and strategic role in the economy development. Currently, ensuring food security is one of the options for the stable development of the country and regions. The implementation of food security in the Russian Federation is carried out in accordance with the Food Security Doctrine. The article offers the author's assessment of food security (independence) of the Volga Federal District based on the indicators listed in the Food Security Doctrine. The article forms a model of food security of both the country and its regions. Its use makes it possible to compare regions with each other most effectively. The model formation is based on the application of cluster analysis, which most fully describes the relationship of the indicators defined in the food security doctrine. According to the results of the study, clusters of regions were formed, by the level of food independence, as a fundamental factor of food security. Clusters also allow to assess the level of food security in the regions of the Volga Federal District. On the basis of clustering, an effective model of food security of the region is built.

1. Introduction
The term "food security" was introduced at the World Conference of the Food and Agriculture Organization of the United Nations (FAO) [1, 2].

Currently, in scientific practice in Russia and abroad, there are a large number of different definitions of the term "food security". Nevertheless, the term that was adopted at the World Food Summit is the most quoted and frequently used: "food security is a condition in which all people of a country at any given time have physical, social and economic access to sufficient nutritious food that meets their needs and is necessary for an active and healthy life" [2, 3].

In the Decree of the President of the Russian Federation dated January 21, 2020 No. 20 "On the approval of the Food Security Doctrine of the Russian Federation", the following definition is given: "food security is the state of social and economic development of the country, in which the food independence of the Russian Federation is ensured, physical and economic accessibility for every citizen of the country of food products that meet mandatory requirements in volumes not less than rational norms of food consumption necessary for an active and healthy lifestyle is guaranteed" [4].
The 2020 Doctrine [4] has been expanded in comparison with the 2010 Doctrine, such indicators as economic and physical accessibility of food have been changed in it, and seeds, vegetables, cucurbits, fruits and berries have also been added as part of food independence. Thus, today food security is formed on the basis of three criteria: food independence, economic accessibility and physical accessibility of food.

Vorobyov S. [5] notes that the new doctrine is aimed at increasing the export component, in contrast to the 2010 doctrine, and identifies three main changes introduced by this decree: excess of export of agricultural products over import; increase in the list of criteria that make up food security; extensions of food products in the doctrine, which are included in the list by which food security is determined.

Fullbrook D. [6] in 2010 noted that food production was not fixed among the priority areas of development, although it is also important for national, and therefore food security, as well as other resources (oil, steel, etc.).

The need for state attention in the field of food security is noted by the authors Payziyeva S. and Paiziev A. [7] who conducted their research in Uzbekistan.

A study on the food security of the Arctic region of the Russian Federation conducted in 2016 [8] notes that it is necessary to strengthen activities in this area both in the legislative aspect and to support entrepreneurial activity in this region.

Currently, there is a general decrease in the level of food security both in the Russian Federation as a whole and in other countries. The trend began in 2020, which is explained by the systemic decline in the economy resulting from the COVID-19 pandemic, which on the one hand undermines the food security of countries due to the physical restrictions of households [9, 10], and on the other hand, this situation is a unique opportunity to develop new strategies within the countries [11]. Reductions in the movement of goods both within the country and abroad may also have an impact on the food security of regions. Currently, it is not possible to assess the impact of COVID-19 in digital data due to their absence in official sources.

This study is devoted to the pre-pandemic period in the field of food security. Previously, the authors have already conducted several studies on the assessment of food security, the main results are presented in relevant scientific studies [2,12,13]

2. Methods and materials

The data sources were the official statistical indicators for the Volga Federal District and the calculations of the authors of the study.

The following methods were used as methods of data analysis:
- cluster analysis - a method of non-hierarchical clustering [12, 13 14];
- panel data model [2, 15], which allows to consider the heterogeneity of objects.

During clustering, data from the website of the Interdepartmental Information and Statistical System (EMISS) were used: gross harvest of agricultural crops, consumption of basic foodstuffs. All indicators were taken per capita. The following indicators were considered: grain harvest; bread consumption; sugar beet harvest; sugar consumption; gross sunflower harvest; vegetable oil consumption; meat and meat products production; meat and meat products consumption; milk production; milk consumption; gross potato harvest; potato consumption; gross vegetable and cucurbits harvest; vegetable and melon consumption; gross fruit and berry harvest; fruit and berry consumption.

3. Results

For grouping and further analysis of the situation in the Volga Federal District in the field of food security, clustering is carried out based on official Rosstat data for the period from 2011 to 2019.

The basis of this study is food independence as a fundamental factor of food security. The indicators used for clustering were calculated data in the field of food security (independence).

Based on the method used to determine the optimal number of cluster groups, the average width of the elbow and the analysis of the results, it was found that for the studied data (2011-2019), the optimal number of clusters is three.
The following models of food independence of the entities of the Volga Federal District were obtained (Figures 1-9)

**Figure 1.** Distribution of entities by clusters 2011.

**Figure 2.** Distribution of entities by clusters 2012.

**Figure 3.** Distribution of entities by clusters 2013.
Figure 4. Distribution of entities by clusters 2014.

Figure 5. Distribution of entities by clusters 2015.

Figure 6. Distribution of entities by clusters 2016.
Based on the regions of the Volga Federal District grouped by clusters presented in Figures 1-9, it can be noted that the clustering of regions did not change significantly throughout the entire period of the study. The group of regions included in the second group, which includes the Republic of Mordovia,
the Republic of Tatarstan, the Penza region, are the most stable in terms of food independence (production of all types of agricultural products), and therefore food security.

4. Conclusion

Despite clustering and the identification of leaders among the subjects of the Volga Federal District, the level of food independence of the regions is at a fairly high level.

At the same time, it is necessary to consider the very large differences that exist between the regions of the Russian Federation, which are due to climatic, geographical, economic, social, and political specifics in the regions of Russia. In particular, a number of regions of the country are characterized by the presence of serious problems in the field of food independence. First of all, these are regions such as the Republic of Buryatia, the Republic of Tyva and the Chukotka Autonomous District [2], which belong to other federal districts.

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