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Research Article

**USING CLUSTER ANALYSIS TO JUSTIFY THE PRIORITY
AREAS OF AGRICULTURAL ORGANIZATIONS INNOVATIVE
DEVELOPMENT.**Oksana Takhumova¹, Igor Bursa¹, Sergey Andreev², Natalia Zinchenko², Elena Kosinova³.

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Article Received: December 2018 **Accepted:** February 2019 **Published:** March 2019**Abstract:**

The most important condition for a qualitative and quantitative breakthrough in the production of agricultural products, an increase in efficiency is the activation of its innovative component. However, it should be noted that the sustainable development of the studied sector depends on the correct choice and adequate zonal distribution of innovations. In this regard, the paper proposes a methodological approach based on the application of the cluster analysis method, adapted to the features of the object of study by substantiating the essential indicators used in the clustering process of milk producers, which include the productivity of the dairy herd taking into account the actual fat and protein content milk, cost of production and profitability. The substantive characteristics of the cluster analysis of milk production are substantiated, the number of clusters and the geographical location is determined. On the basis of the obtained results, a matrix of classification of organizations in a regional system based on observable classes is presented.

Keywords: milk-producing subcomplex, region, cluster analysis, matrix.**Corresponding author:**

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INTRODUCTION:

Dairy cattle breeding is one of the most difficult sub-sectors of agriculture. This is due to the high capital intensity and laboriousness of technological processes, as well as a long period of the reproduction cycle. It should be borne in mind here that more than half of milk in Russia is produced in personal subsidiary farms. If at present, according to experts, in the agricultural organizations of Russia a modern scientific and technical level of production is equivalent to the level of the 1970 in the individual sector, the current lag is deeper and does not exceed the level of the 50s. The twentieth century [1].

When analyzing the performance of 191 agricultural organizations of the Krasnodar Territory engaged in the production and sale of milk in 2017, a large variation of their technological and economic indicators was noted. In our opinion, one of the most adequate tools for such an analysis is the cluster method, which allows for the classification of heterogeneous statistical aggregates, combining them into groups that are homogeneous in several indicators (cluster).

Reznichenko S.M. [2] believes that "... the goal of cluster analysis is to search for existing structures. Evaluating cluster analysis as a research method, Fursov V.A. [3] identifies two of his essential methodological features: the justification of a single measure covering a

number of signs, and a purely quantitative solution of the question of grouping objects of observation.

Takhumova O.V. [3] believe that cluster analysis allows solving the problem of organizing various indicators characterizing the innovation activities of commodity producers into visual structures, i.e. to conduct a taxonomy, involving systematization, hierarchical construction of a group of objects according to a definite attribute or set of attributes.

MATERIAL AND METHODS:

In determining the priorities for the integrated development of dairy cattle breeding in the region, cluster analysis can be used in several aspects. The first field of application is the identification of problems and the formation of a group of farms with low development indicators that need reorganization and investment assistance. The second aspect of the analysis is the assessment of the potential and the selection of agricultural organizations that can become "flagships and locomotives" of development, an example of skillful management, as well as a rational allocation of investment funds and their innovative use.

To simplify the procedure for determining the factors that most fully reflect the state of milk producers, a scheme was drawn up (Figure 1), where all indicators are conventionally divided into two parts – economic and technological.

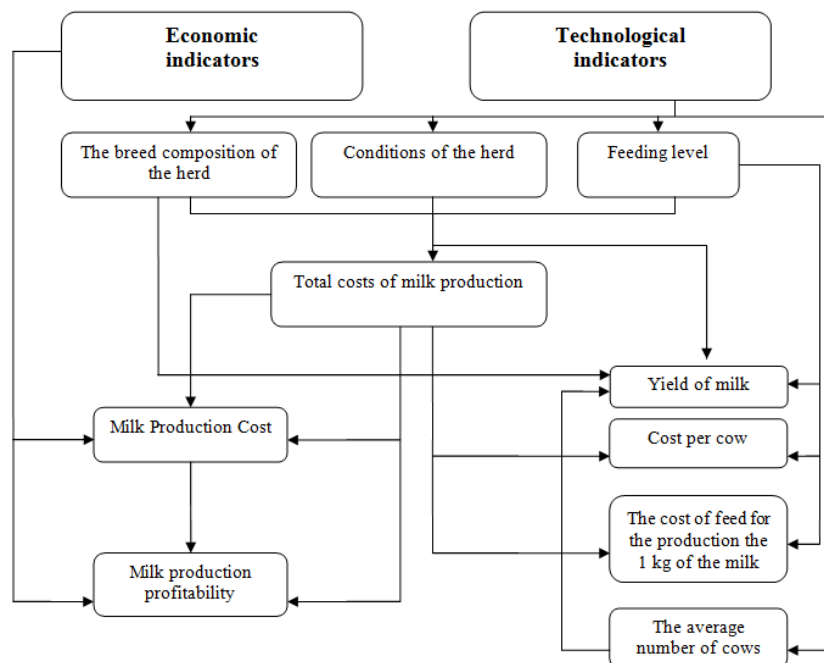


Figure 1: Grounding the essential characteristics of the milk production cluster analysis

RESULTS AND DISCUSSION:

To divide the aggregate into clusters, an application package was used for statistical processing and visualization of Statistica 10.0 data. The dendrogram of 191 agricultural enterprises of the Krasnodar Territory

engaged in the production of milk is shown in Figure 2. It can be seen from the figure that the studied set of enterprises initially form three large clusters, which are then divided into five, etc.

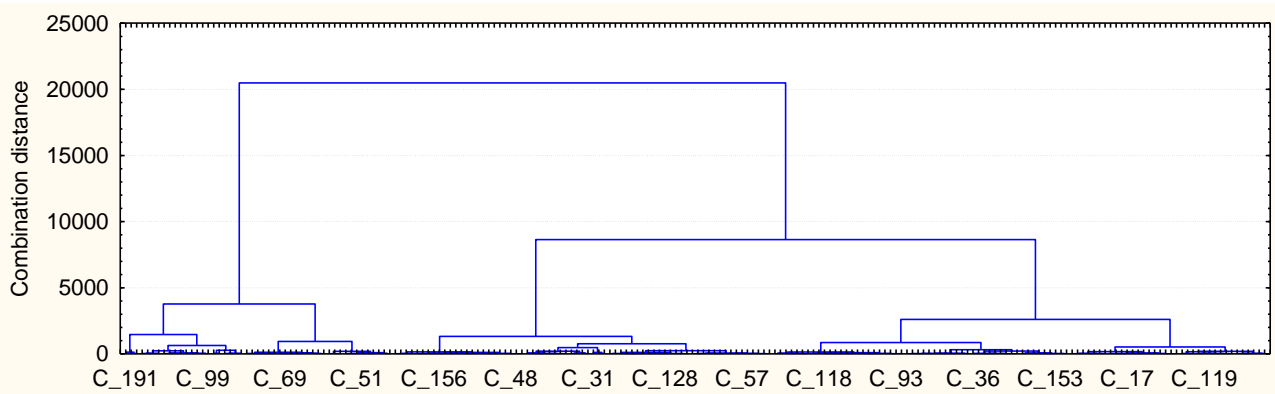


Figure 2: Agricultural organizations dendrogram of the Krasnodar Region (association rule - Ward method, proximity measure - Euclidean distance, 191 observation)

At this stage of the study, the task was to obtain a multidimensional classification of agricultural enterprises of the Krasnodar Territory according to the level of development of dairy cattle breeding. The resulting division into five clusters (groups) allows for some comparative analysis of the average values of clusters and to chart ways for further innovation and investment development of enterprises. However, it should be noted that due to the relatively large number of groups, further analysis is rather cumbersome and

difficult to see. Therefore, for the further analysis, three integrated clusters were selected.

As a result of the division of agricultural enterprises into three classes (amalgamation distance of 5,000) using the k-average method, 61 enterprises were included in the first cluster, 67 enterprises entered the second cluster, 63 - the third.

In the third class, all average values of indicators exceed the corresponding values of the second and first class (Table 1).

Table 1: Average values of variables in the formation of three clusters of agricultural enterprises engaged in milk production in the Krasnodar Region

Variable	Average value		
	cluster 1	cluster 2	cluster 3
Milk content with basic fat and protein content, c	43,16	55,19	62,92
The number of cows per 100 hectares of farmland, goal.	6,82	8,31	9,55
Production costs per cow, thousand rubles	71,8	80,61	87,01
Feed consumption for the production of 1 centner of milk with basic content of fat and protein, centner feed units	1,33	1,08	1,01
The cost of 1 kg of milk with basic fat and protein, rub./kg	1457	1222	1151
Profitability of production, %	-2,33	17,98	30,92

95-% confidence intervals for average values of indicators convincingly show a steady order of quality of classification of agricultural organizations of the Krasnodar Territory for all indicators: 3 cluster, 2 clusters, 1 cluster.

Using the resulting classification using discriminant analysis allows you to find the classification function of

new objects belonging to one of the classes according to the highest value of the corresponding function. We will select the grouping - "cluster" and independent variables, according to which the classification was made. Table 2 reflects the resulting linear classification functions.

Table 2: The classification functions for the grouping - "cluster"

Variable	Classification functions		
	G_1:1 P=0,1635	G_2:2 P=0,4135	G_3:3 P=0,4231
Milk yield with basic fat and protein content, c	3,820	3,652	3,844
The number of cows per 100 hectares of farmland, goal.	0,354	0,295	0,344
Production costs per cow, thousand rubles	3,103	2,909	3,104
Feed consumption for the production of 1 centner of milk with basic content of fat and protein, centner feed units	14,719	15,538	15,601
The cost of 1 kg of milk with basic fat and protein, rub./kg	0,354	0,300	0,291

Profitability of production,%	0,518	0,525	0,623
Constant	225,128	167,068	160,284

The classification matrix shows that almost 93.3% of enterprises are classified correctly (Table 3).

Table 3: Enterprise Classification Matrix

Observable class	Correctness percentage	Predicted class		
		G_1:1 P=0,1635	G_2:2 P=0,4135	G_3:3 P=0,4231
G_1:1	91,176	31	3	0
G_2:2	96,512	0	83	3
G_3:3	90,909	0	8	80
Total	93,269	31	94	83

The graphical depiction of classes also indicates a good classification of enterprises - Figure 3. The first canonical root discriminates all 3 classes, which illustrates the adequacy of the classification.

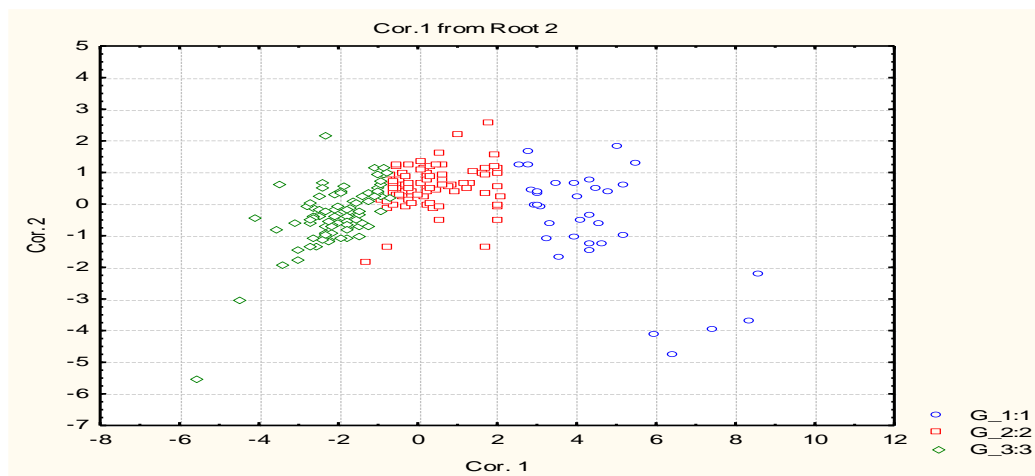


Figure 3: Cluster Graphic

The matrix of the factor structure (the table of correlation coefficients between the parameters and factors - canonical roots) of the solution obtained makes it possible to estimate the contribution of variables to the classification obtained through connection with canonical roots: the first root is most strongly associated

with the cost price of a unit of basic milk and feed consumption for the production of 1 c of milk, the second - with production costs per cow and milk yield (Table 4). Thus, we can assume that the available data are mainly due to the above factors.

Table 4: Matrix of factor structure

Variable	Canonical root	
	root 1	root 2
Milk yield with basic fat and protein content, c	-0,185834	0,151444
The number of cows per 100 hectares of farmland, goal.	-0,084298	0,079786
Production costs per cow, thousand rubles	0,151885	0,308387
Feed consumption for the production of 1 centner of milk with basic content of fat and protein, centner feed units	0,247291	-0,241151
The cost of 1 kg of milk with basic fat and protein, rub./kg	0,982843	-0,132286
Profitability of production,%	-0,711626	-0,442928

CONCLUSION:

Now the issues of data analysis and dependency search can be solved in each of the classes separately. When a new enterprise appears with the help of classification functions, it should be attributed to one of the three classes, and then, using regression dependencies, to evaluate the necessary performance indicators.

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