ARGUMENTA OECONOMICA
No 2 (49) 2022
ISSN 1233-5835; e-ISSN 2720-5088

Ivan F. Gorlov, Marina I. Slozhenkina**, Oleg A. Kholodov***, Marina A. Kholodova****, Olga P. Shakhbazova*****, Daria A. Mosolova******, Mohammadreza Poorghasemi*******, Alireza Seidavi*********

A NOVEL METHOD TO DETERMINE THE GROWTH POTENTIAL OF AGRICULTURAL ENTERPRISES IN VARIOUS BUSINESS PLANS

This article presents different models useful in identifying the potential for enhancing the performance of agricultural enterprises of various business forms and scales. A clustering method developed by the authors was used to calculate an integral indicator of the development potential of agricultural enterprises within larger organizational and legal units. The model allows enterprises of all structures/scales to emphasize different performance indicators of interest. Moreover, distinctive characteristics of the performance growth potential of various business forms were revealed.

Keywords: agricultural production; algorithm; business development; cluster analysis

JEL Classification: N54, O13, Q13
DOI: 10.15611/aoe.2022.2.11

©2022 Ivan F. Gorlov, Marina I. Slozhenkina, Oleg A. Kholodov, Marina A. Kholodova, Olga P. Shakhbazova, Daria A. Mosolova, Mohammadreza Poorghasemi, Alireza Seidavi
This work is licensed under the Creative Commons Attribution-Share Alike4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by-sa/4.0/

Quote as: Gorlov, F. I., Slozhenkina I. M., Kholodov, A. O., Kholodova, A. M., Shakhbazova, P. O., Mosolova, A. D., Poorghasemi, M., Seidavi, A. (2022). A novel method to determine the growth potential of agricultural enterprises in various business plans. *Argumenta Oeconomica*, 2(49).

* Volga Research Institute of Production & Processing of Meat & Dairy Products, Volgograd, Russia. ORCID: 0000-0002-8683-8159.
** Volga Research Institute of Production & Processing of Meat & Dairy Products, Volgograd, Russia. ORCID: 0000-0001-9542-5893.
*** Rostov State Economic University, Rostov-on-Don, Russia. ORCID: 0000-0002-3629-8086.
**** All-Russian Research Institute of Economics and Standards, Federal Rostov Agrarian Scientific Center (branch), Rostov-on-Don, Russia. ORCID: 0000-0001-9808-8263.
***** Don State Agrarian University, Persianovsky, Rostov-on-Don, Russia. ORCID: 0000-0001-9810-0162.
****** Volga Research Institute of Production & Processing of Meat & Dairy Products, Volgograd, Russia. ORCID: 0000-0001-9810-0162.
******* Department of Animal Science, Faculty of Agriculture, Rasht Branch, Islamic Azad University, Rasht, Iran. ORCID: 0000-0001-9199-0828.
******** Department of Animal Science, Faculty of Agriculture, Rasht Branch, Islamic Azad University, Rasht, Iran. ORCID: 0000-0002-1903-2753.

1. INTRODUCTION

The ongoing economic reforms in the Russian agricultural sector include changes in ownership and the adoption of business methods for developing market relations. Together with general growing economic interest in agricultural production, these changes have driven the development of various new organizational and legal structures in the industry (Monden, 1989; De Silva et al., 2012). The increased use of improved business mechanisms by medium and large agricultural enterprises have fuelled the development of systemswhere agricultural businesses could be classified based on legal ownership and revenue distribution. Differences in forms of ownership of the means of production now determine the legal classification of agricultural enterprises as they are formatted and/or reorganized (Sugiharto et al., 2018).

The classification of business organizational and legal forms is defined by the Civil Code of the Russian Federation and distinguishes partnerships, limited liability companies, production cooperatives, state enterprises, joint-stock companies, and others. The most widespread forms in Russian agriculrure are limited liability companies, production cooperatives, joint-stock companies, and state enterprises (Monden, 1989).

Various organizational and legal entities allow agricultural enterprises to address a number of issues aimed at maximising profit, enhancing product yield, forming an adequate distribution system, and employing a complex mechanism of economic interests, incentives, and labour motivation thereby enhancing the productivity of all agricultural business forms, which is of particular importance (Poorghasemi et al., 2013).

It is a fundamental truth that effective agricultural production does not depend on a business form and it is important for the main segments to provide benefits to all facets of an enterprise. These include dividends paid to the owners (founders) of the enterprise, adequate material incentives for employees, incentive mechanisms aimed at increasing labour productivity, and distribution of income received, ensuring at least its reproduction on a simple scale. The business form cannot guarantee the performance of agricultural production, it only determines the legal and economic rules and norms that are applied in the business (Mengistu et al., 2017; Poorghasemi et al., 2017).

There are various scientific definitions of production performance (Smagin et al., 2002; Monden, 1989; Makin, 1998; Poorghasemi et al., 2015). These definitions generally do not contradict one another, but rather they complement each other in describing this multifaceted economic category. The authors believe that agricultural production performance is a function of key production, economic, and financial indicators that are objectively applicable to specific environmental, climatic, and economic conditions, and of particular scientific interest is the performance of agricultural enterprises of various business forms. In the research presented here,

agricultural enterprises were distinguished with respect to their business forms, which ensured the most objective analysis of their performance and growth potential, as the variables in the definition of production performance may be impacted in different ways by different business forms; the integration in question achieved the greatest identity in terms of applied elements of the intra-economic mechanism.

2. MATERIALS AND METHODS

The objective of this research was to measure the performance of agricultural enterprises operating under different organizational and legal mechanisms and various business forms. The information-analytical basis of the study was the data from the annual reports of agricultural enterprises of the Rostov region for 2018. A cluster analysis with the STATISTICA® 13 software (TIBCO Software, Inc., Palo Alto, CA) applied data from the annual reports of agricultural enterprises of the Rostov region for the 2018 to measure the performance of agricultural enterprises. This allowed to identify characteristics that were the basis for arranging enterprises or distinctive performance characteristics of organizations within each organizational and legal form. During clustering, hierarchical algorithms and the K-means method were used to analyse the data. Since the use of only one clustering algorithm does not always produce reliable estimates (Bogoviz et al., 2019; Altukhov and Rassadin, 2015), the methodology for determining the growth potential and economic efficiency of agricultural enterprises of various forms of management consisted of four main stages.

2.1. Stage 1

The data set within the framework of one organizational and legal form of business was subjected to the normalisation procedure. This allowed the transformation of the initial variables expressed in different units of measurement into dimensionless values.

2.2. Stage 2

The hierarchical algorithms were applied in the second stage. In particular, clustering trees were created based on the Ward method, which involves sequentially dividing the initial set of objects into clusters by calculating the distance between them and separating objects with the smallest possible distance between them into clusters. The calculations used the Euclidean (geographical) distance, and the results are presented in the form of dendrograms.

2.3. Stage 3

In order to assess how different clusters were generated, the study used the *K*-means method to divide the studied group into a given number of *K*-different

clusters. This methodological approach allowed to calculate the average for each cluster for each measurement group. The degree of proximity and differences of clusters were studied using dispersion analysis and a graphical interpretation of cluster centres. The reliability of the results was based of inter-group and intra-group variance, values of *F*-statistics, and others.

2.4. Stage 4

At the final stage, using the results of clusterisation, the integral indicator of the development potential of agricultural enterprises in various organizational and legal forms of management was calculated using the following formula

$$C = \frac{1}{Ncl} \sum_{i=1}^{n} \left(\frac{P\max_i}{Pn_i} Vcl_{ni} \right), \tag{1}$$

where C is the integral indicator characterising the growth potential of enterprises of one legal form; $P\max_i$–the maximum i indicator value among the clusters obtained; Pn_i – the n-cluster value of the i indicator; Vcl_{ni}– the specific gravity of a cluster, which can be calculated by the formula

$$Vcl = \frac{Fcl_n}{\sum F}, \tag{2}$$

where Fcl_n– is the number of enterprises of the nth cluster; F – is the total number of enterprises; Ncl_n– is the number of clusters.

3. RESULTS

The clusters were developed using data collected from 640 agricultural enterprises in the Rostov region and were based on the following characteristics: the area of agricultural land and arable land; current and fixed assets; revenue; cost; profit; number of employees; and labour remuneration fund. In order to reduce the dependence of the indices on the unit of measurement and scale, all indicators were standardised.

Initially, using the hierarchical algorithm, the authors elucidated a tree-like clustering of the performance of public joint-stock companies using the Ward method and the Euclidean distance function which are presented as a dendrogram (Figure 1).

From Figure 1, eight clusters of public joint-stock companies that had common characteristics were distinguished. Using the *K*-means method, eight clusters of public joint-stock companies were formed, and their proximity and difference were determined using variance analysis (Table 1). Since all *F*-criterion values are significant ($P < 0.05$), it can be argued that all characteristics were selected objectively. Their quantitative characteristics are presented in Figure 2 and Table 2.

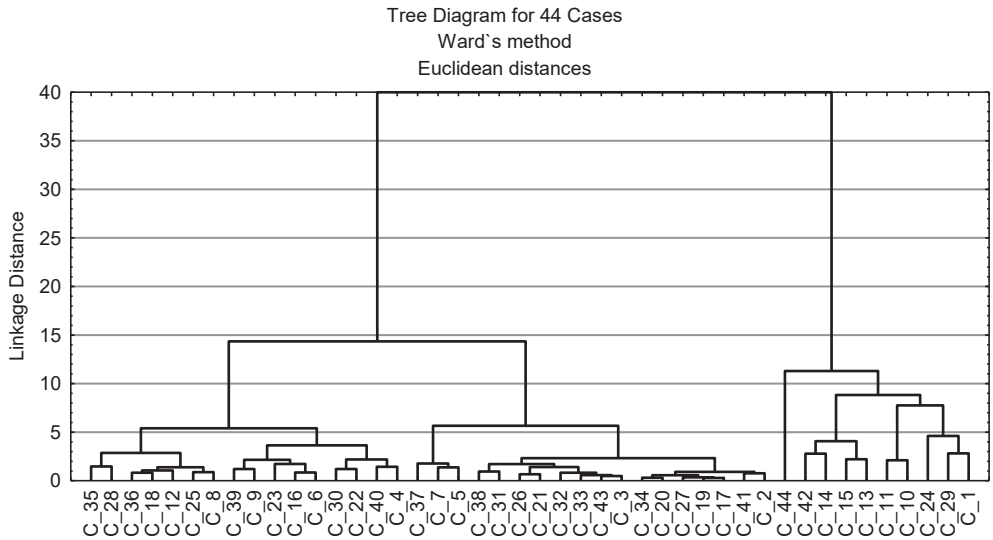

Fig. 1. Dendrogram of public joint-stock agricultural companies in the Rostov region

Source: developed by the authors.

Figure 2 shows that the values of the characteristics of Clusters 3, 4 and 8, and distinguished these clusters from others. The remaining clusters had similar values of the indicators such as the agricultural land area, current assets, and profit. However, most of the characteristics of all the clusters had their own features. The cluster analysis of public joint-stock companies interpreted by the K-means method is presented as a plot (Figure 2).

Table 1

Variance analysis of clusters of public joint-stock agricultural companies in the Rostov region in terms of their performance in 2018

Indicator (characteristic)	**Variance between groups**	**Number of freedom degrees**	**Within-group variance**	**Number of freedom degrees**	***F***	***P*-value**
1	2	3	4	5	6	7
Area of agricultural land, ha	38.60268	7	4.397316	36	45.14756	0.000000
Arable land, ha	36.79657	7	6.203426	36	30.50564	0.000000
Current assets, thousand USD	34.12348	7	8.876518	36	19.77039	0.000000
Revenues, thousand USD	40.09695	7	2.903053	36	71.03310	0.000000

1	2	3	4	5	6	7
Cost of sales, thousand USD	37.22765	7	5.772350	36	33.16786	0.000000
Profit, thousand USD	34.46487	7	8.535130	36	20.76687	0.000000
Fixed assets, thousand USD	36.64098	7	6.359016	36	29.63341	0.000000
Average annual number of employees, people	34.04181	7	8.958191	36	19.54325	0.000000
Labour remuneration fund, thousand USD	35.73274	7	7.267262	36	25.28716	0.000000

Source: developed by the authors.

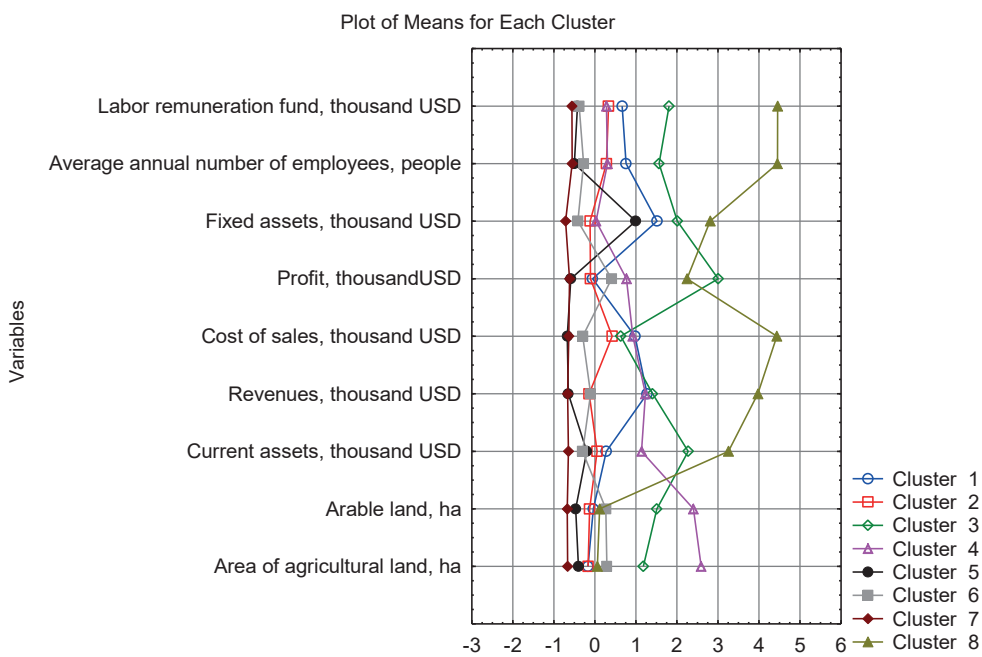

Fig. 2. Plot of means for each cluster of public joint-stock agricultural companies in the Rostov region

Source: developed by the authors.

Taking into account that all the economic entities under consideration were in equal climatic and economic environments, it was assumed that each agricultural enterprise, with the business mechanism being appropriately adjusted, could achieve the top performance obtained by other organizations within one legal form.

Table 2

Performance indicators of public joint-stock agricultural companies by cluster in the Rostov region in 2018

Indicator (characteristic)	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**	**Cluster 6**	**Cluster 7**	**Cluster 8**
Number of organizations, units	125.3	41.5	48.5	27.5	20.4	28.4	32.1	205.0
Marketable output per 100 ha of agricultural land, thousand USD	7.8	7.3	14.6	3.8	3.7	8.1	5.5	23.8
Profit per 100 ha of agricultural land, thousand USD	9.7	12.8	56.6	20.1	24.7	45.7	19.0	13.2
Production profitability, %	123.9	48.0	53.9	13.2	135.9	22.4	47.2	145.7
Capital-labour ratio, thousand USD / 100 ha	0.014	0.012	0.013	0.03	0.002	0.018	0.01	0.02
Capital productivity ratio, USD	0.0009	0.002	0.004	0.004	0.0004	0.005	0.002	0.002
Return on assets, USD	0.06	0.15	0.27	0.29	0.03	0.36	0.12	0.16

Source: developed by the authors.

The authors developed a method for calculating the integral indicator of the development potential of enterprises in the framework of one legal form. The hierarchical clustering of non-public joint-stock companies made it possible to distinguish five clusters (Figure 3).

Five clusters were formed using the K-means method. The variance analysis is presented in Table 3. The average performance was interpreted on a plot, which allowed forming groups (Figure 4). In terms of the average annual value of working capital, Clusters 1 and 5 and Clusters 2 and 3 were closest in proximity to one another. Shared performance indicators of clusters of non-public joint-stock companies showed that Clusters 1, 3 and 4 contained groups with average values of 35.4 to 65.2 thousand USD in terms of the marketable output per 100 ha of agricultural land, with their profitability ranging from 17.5% to 25.8%, and returns on assets from 0.02 to 0.03USD (Table 4).

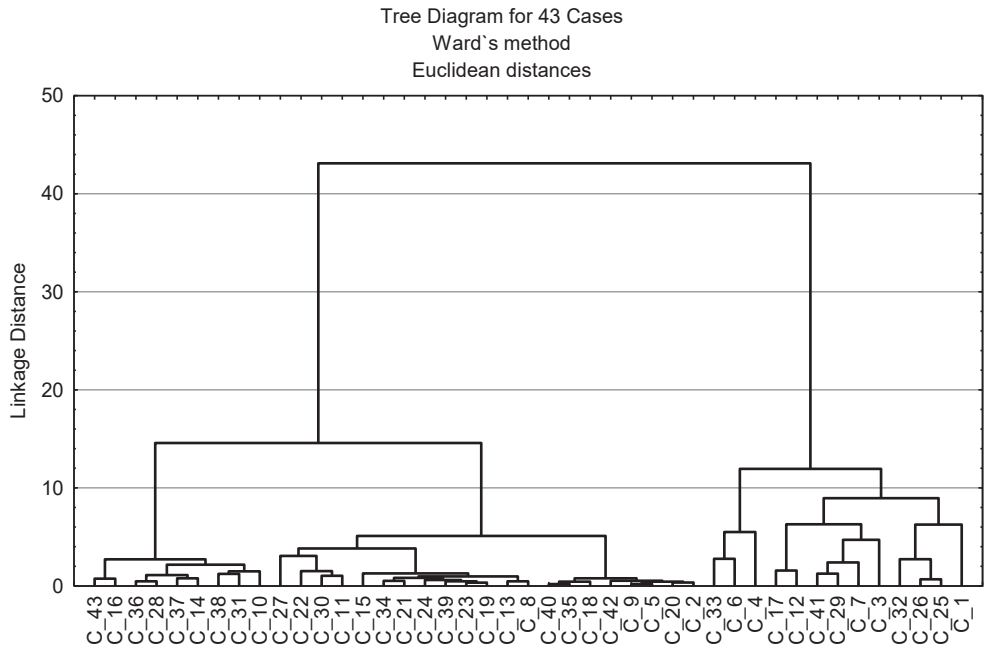

Fig. 3. Dendrogram of non-public joint-stock agricultural companies in the Rostov region

Source: developed by the authors.

Table 3

Variance analysis of clusters of non-public joint-stock agricultural companies in the Rostov region in terms of their performance in 2018

Characteristic	**Variance between groups**	**Number of freedom degrees**	**Within-group variance**	**Number of freedom degrees**	***F***	***P*-value**
1	2	3	4	5	6	7
Area of agricultural land, ha	32.46189	4	9.53811	38	32.3322	0.000000
Arable land, ha	32.77942	4	9.22058	38	33.7728	0.000000
Current assets, thousand USD	22.95722	4	19.04278	38	11.4528	0.000003
Revenues, thousand USD	38.02255	4	3.97745	38	90.8155	0.000000
Cost of sales, thousand USD	38.50308	4	3.49692	38	104.6004	0.000000
Profit, thousand USD	16.70210	4	25.29790	38	6.2721	0.000561

1	2	3	4	5	6	7
Fixed assets, thousand USD	37.47293	4	4.52707	38	78.6366	0.000000
Average annual number of employees, people	31.73390	4	10.26610	38	29.3658	0.000000
Labour remuneration fund, thousand USD	31.69533	4	10.30467	38	29.2203	0.000000

Source: own study.

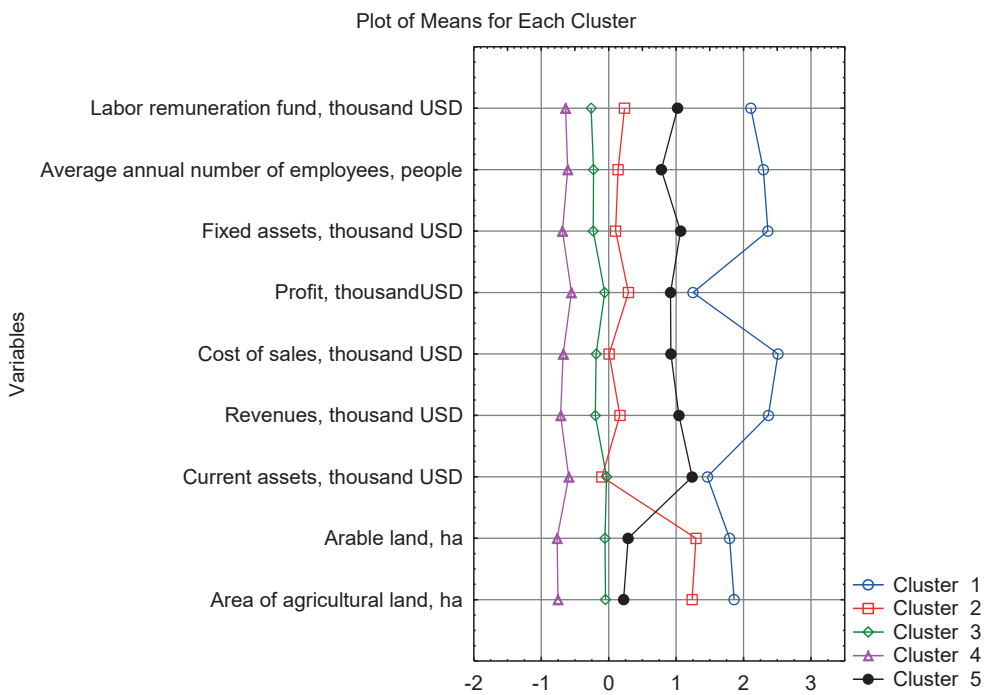

Fig. 4. Plot of means for each cluster of non-public joint-stock agricultural companies in the Rostov region

Source: developed by the authors.

Cluster 2 included enterprises with low land use efficiency, poor equipment, and high profitability of their performances. Cluster 5 comprised agricultural livestock enterprises that had large production volumes and relatively small areas of farmland, which increased their fixed assets (Table 4).

Table 4

Performance indicators of non-public joint-stock agricultural companies by cluster in the Rostov region in 2018

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Number of organizations, units	4	5	10	19	5
Marketable output per 100 ha of agricultural land, thousand USD	49.7	22.0	32.4	31.8	65.2
Profit per 100 ha of agricultural land, thousand USD	7.2	4.7	6.6	4.9	12.8
Production profitability, %	17.5	31.6	25.8	18.4	26.5
Capital-labour ratio, thousand USD/100 ha	60.2	24.4	35.5	35.4	79.1
Capital productivity ratio, USD	0.012	0.013	0.013	0.013	0.012
Return on assets, USD	0.002	0.003	0.003	0.002	0.002

Source: own study.

Of great scientific interest is the clustering of limited liability companies (LLCs), which comprised 416 of the organizations in this data set. The dendrogram resulting from clustering of LLCs indicated the dominance of five groups in the industry (Figure 5).

$$\begin{aligned}
C_{NJSC} = &\left(\frac{65.2}{49.7}0.093+\frac{65.2}{22.0}0.116+\frac{65.2}{32.4}0.233+\frac{65.2}{31.8}0.442\right)\div 4+\\
&+\left(\frac{12.8}{7.2}0.093+\frac{12.8}{4.7}0.116+\frac{12.8}{6.6}0.233+\frac{12.8}{4.9}0.442\right)\div 4+\\
&+\left(\frac{0.45}{0.25}0.093+\frac{0.45}{0.37}0.233+\frac{0.45}{0.26}0.442+\frac{0.45}{0.38}0.116\right)\div 4+\\
&+\left(\frac{79.1}{60.2}0.093+\frac{79.1}{24.4}0.116+\frac{79.1}{35.5}0.233+\frac{79.1}{35.4}0.442\right)\div 4+\\
&+\left(\frac{0.013}{0.012}0.093+\frac{0.0.3}{0.013}0.116+\frac{0.013}{0.013}0.442+\frac{0.013}{0.012}0.116\right)\div 4+\\
&+\left(\frac{0.003}{0.002}0.093+\frac{0.003}{0.001}0.442+\frac{0.003}{0.002}0.116\right)\div 4=\\
&=0.460+0.523+0.338+0.501+0.199+0.221=2.242.
\end{aligned} \tag{3}$$

The *K*-means method made it possible to form five clusters of LLC; the variance analysis of the cluster characteristics is given in Table 5. As described in Figure 6, Clusters 3 and 5 had the greatest similarities in all indicators of their performance.

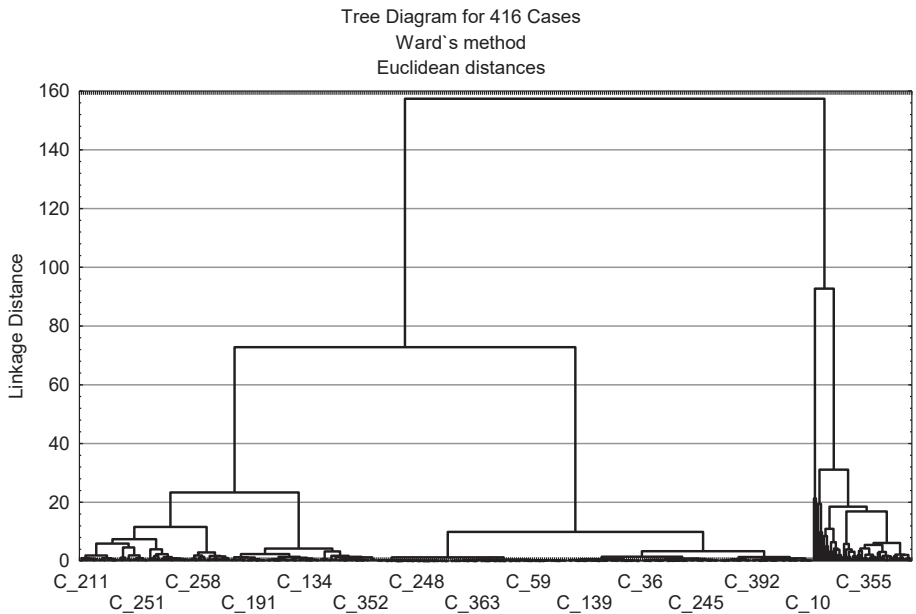

Fig. 5. Dendrogram of limited liability agricultural companies in the Rostov region

Source: developed by the authors.

Table 5

Variance analysis of clusters oflimited liability agricultural companies in the Rostov region based on their performance in 2018

Indicator (characteristic)	**Variance between groups**	**Number of freedom degrees**	**Within--group variance**	**Number of freedom degrees**	***F***	***P*-value**
Area of agricultural land, ha	328.1554	4	86.8446	411	388.256	0.00
Arable land, ha	241.1062	4	173.8938	411	142.464	0.00
Current assets, thousand USD	297.0970	4	117.9030	411	258.914	0.00
Revenues, thousand USD	391.4037	4	23.5963	411	704.365	0.00
Cost of sales, thousand USD	356.1995	4	58.8005	411	622.435	0.00
Profit, thousand USD	342.0031	4	72.9969	411	481.402	0.00
Fixed assets, thousand USD	314.5013	4	100.4987	411	321.546	0.00
Average annual number of employees, people	356.2060	4	58.7940	411	622.515	0.00
Labour remuneration fund, thousand USD	365.2124	4	49.7876	411	753.714	0.00

Source: developed by the authors.

The authors' own calculations of the performance of the formed groups of limited liability companies found similar indicators among these clusters (Table 6).

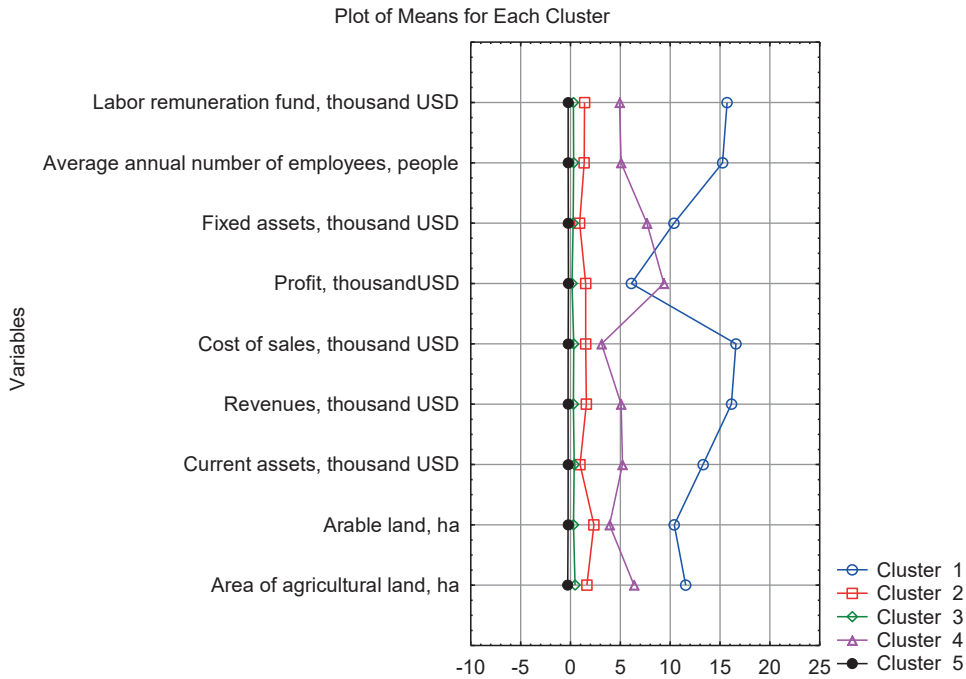

Fig. 6. Plot of means for each cluster of limited liability agricultural companies in the Rostov region

Source: developed by the authors.

Table 6

Performance indicators of limited liability agricultural companies by cluster in the Rostov region in 2018

Indicator (characteristic)	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Number of organizations, units	1	11	85	3	316
Marketable output per 100 ha of agricultural land, thousand USD	60.2	41.0	31.6	35.0	37.1
Profit per 100 ha of agricultural land, thousand USD	6.9	11.2	6.3	18.3	6.1
Production profitability, %	16.5	41.9	27.7	80.6	24.4
Capital-labour ratio, thousand USD/ 100 ha	54.1	36.0	40.2	71.1	40.7
Capital productivity ratio, USD	0.116	0.116	0.007	0.007	0.011
Return on assets, USD	0.002	0.004	0.002	0.004	0.002

Source: developed by the authors.

Clusters 3 and 5 included 401 enterprises, or 96.4% of all the agricultural LLCs. The two clusters accounted for 1,579 thousand ha of agricultural land (27.7% of the region's farmland). Clusters 3 and 5 were characterised by poor performance indicators in comparison with other groups (Table 6). The cluster analysis of agricultural LLCs revealed a segment that included one large enterprise LLC "Agrocomplex Rostovskiy". This enterprise was distinguished by large production and economic indicators (Appendix 10), i.e. agricultural land area of 148.9 thousand ha, however its profitability was the lowest among the clusters identified (Table 6).

Cluster 4 was the next largest segment that comprised three farms: LLC Agro Soyuz Yug Rusi, LLC Svetly, and LLC Agrofirm Tselina. The average area of agricultural land of the enterprises in Cluster 4 was 84,505.7 ha. The agricultural performance of these enterprises was high. Their profitability of 80.6% was higher than the overall average (38%) of the LLCs by 42 points (Table 6).

Cluster 2 was formed by large enterprises of high performance of their fixed assets (Table 6). The integral indicator calculation of the performance potential of LLCs had the following form

$$\begin{aligned}
C_{LLC} = &\left(\frac{60.2}{41.0}0.026+\frac{60.2}{31.6}0.204+\frac{60.2}{35.0}0.007+\frac{60.2}{31.7}0.760\right)\div 4+\\
&+\left(\frac{18.3}{6.9}0.002+\frac{18.3}{11.2}0.026+\frac{18.3}{6.3}0.204+\frac{18.3}{6.1}0.760\right)\div 4+\\
&+\left(\frac{1.2}{0.24}0.002+\frac{1.2}{0.60}0.026+\frac{1.2}{0.40}0.204+\frac{1.2}{0.35}0.760\right)\div 4+\\
&+\left(\frac{71.1}{54.1}0.002+\frac{71.1}{36.1}0.026+\frac{71.1}{40.2}0.204+\frac{71.1}{40.7}0.760\right)\div 4+\\
&+\left(\frac{0.016}{0.02}0.002+\frac{0.016}{0.011}0.204+\frac{0.016}{0.007}0.007+\frac{0.016}{0.011}0.760\right)\div 4+\\
&+\left(\frac{0.004}{0.0019}0.002+\frac{0.004}{0.0023}0.204+\frac{0.004}{0.0037}0.007+\frac{0.004}{0.0022}0.760\right)\div 4=\\
&=0.471+0.730+0.791+0.436+0.354+0.495=3.277.
\end{aligned} \tag{4}$$

Clustering of 137 agricultural production cooperatives in the Rostov region based on the hierarchical algorithm method identified five clusters (Figure 7).

Five clusters were formed using the K-means method. The variance analysis of the performance indicators of agricultural production cooperatives is presented in Table 7.

Table 8 presents the calculated performance of production cooperatives clusters. One should note Cluster 2 that included two enterprises, i.e. APC AF Novobatayskaya and APC Shaumyan's collective farm. These enterprises had a large yield of marketable products and profit per unit area of agricultural land as well

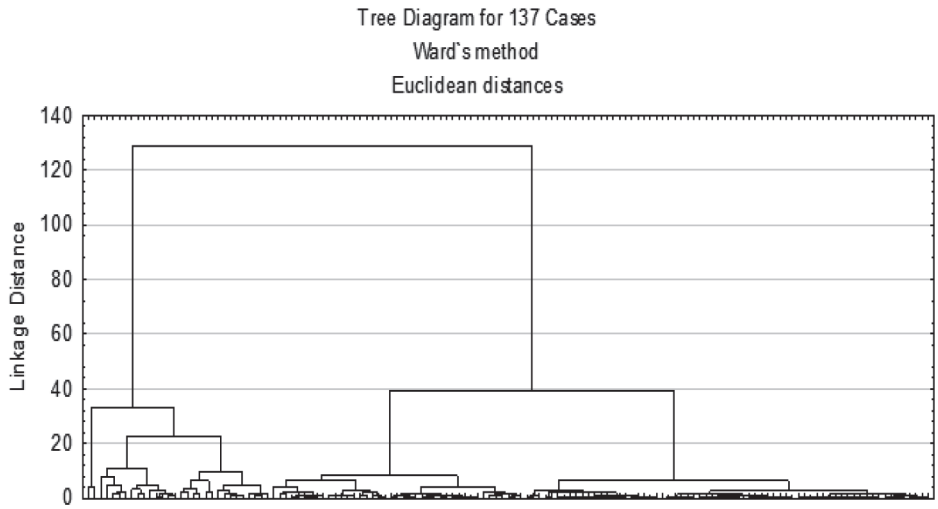

Fig. 7. Dendrogram of agricultural production cooperatives in the Rostov region

Source: developed by the authors.

Table 7

Variance analysis of clusters of agricultural production cooperatives in the Rostov region in terms of their performance in 2018

Indicator (characteristic)	**Variance between groups**	**Number of freedom degrees**	**Within--group variance**	**Number of freedom degrees**	***F***	***P*-value**
Area of agricultural land, ha	100.6787	4	35.32129	132	94.0622	0.000000
Arable land, ha	103.9578	4	32.04224	132	107.0651	0.000000
Current assets, thousand USD	120.1965	4	15.80347	132	250.9882	0.000000
Revenues, thousand USD	118.9587	4	17.04131	132	230.3600	0.000000
Cost of sales, thousand USD	118.1350	4	17.86496	132	218.2180	0.000000
Profit, thousand USD	88.3556	4	47.64445	132	61.1977	0.000000
Fixed assets, thousand USD	110.4525	4	25.54748	132	142.6729	0.000000
Average annual number of employees, people	112.1700	4	23.82998	132	155.3342	0.000000
Labour remuneration fund, thousand USD	123.7199	4	12.28010	132	332.4694	0.000000

Source: developed by the authors.

as good technical equipment, which is likely dictated by their specialisation (seed production and dairy cattle breeding, see Table 8).

The highest profitability, however, was registered in Cluster 1 farms (20.7%). This cluster was also characterised by large land areas used for agricultural production (Table 8, Figure 8).

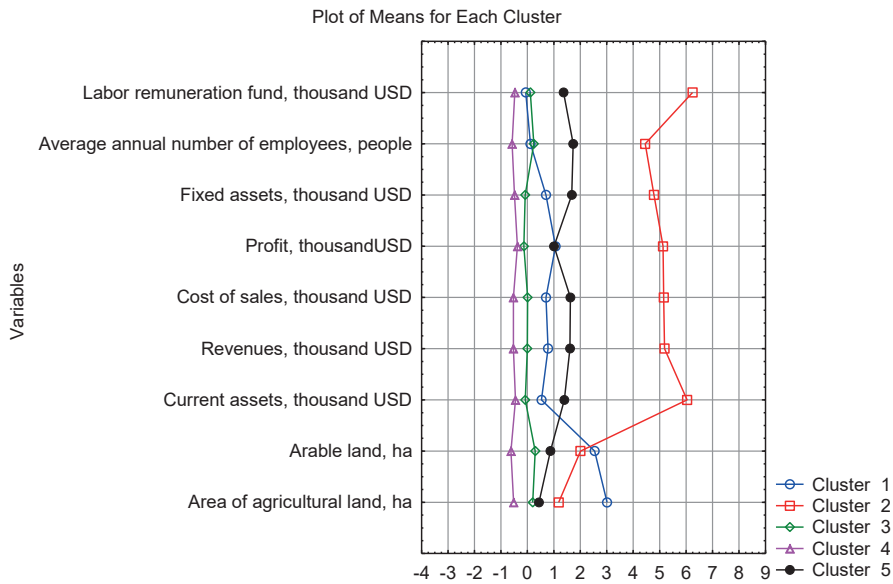

Fig. 8. Plot of means for each cluster of agricultural production cooperatives in the Rostov region

Source: developed by the authors.

Table 8

Performance indicators of agricultural production cooperatives in terms of clusters in the Rostov region in 2018

Indicator (characteristic)	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Number of organizations, units	8	2	35	77	15
Marketable output per 100 ha of agricultural land, thousand USD	12.7	93.2	22.0	18.4	57.8
Profit per 100 ha of agricultural land, thousand USD	2.2	14.6	2.1	2.6	6.3
Production profitability, %	20.7	17.6	10.4	16.8	12.1
Capital-labour ratio, thousand USD/100 ha	15.3	114.8	23.3	21.5	77.2
Capital productivity ratio, USD	0.012	0.012	0.014	0.012	0.011
Return on assets, USD	0.002	0.002	0.001	0.002	0.001

Source: own study.

Using all the methods described above, the authors built a matrix of integrated indicators of the growth potential of agricultural enterprises in the Rostov region in the context of legal forms of the enterprises (Table 9).

The calculation of the integral indicators of the growth potential of the performance of agricultural cooperatives was as follows

$$\begin{aligned} C_{APC} = & \left(\frac{93.2}{12.7}0.058+\frac{93.2}{22.0}0.255+\frac{93.2}{18.4}0.562+\frac{93.2}{57.8}0.109\right)\div 4+ \\ & +\left(\frac{14.6}{2.2}0.058+\frac{14.6}{2.1}0.255+\frac{14.6}{2.6}0.562+\frac{14.6}{6.3}0.109\right)\div 4+ \\ & +\left(\frac{0.30}{0.25}0.015+\frac{0.30}{0.15}0.255+\frac{0.30}{0.24}0.562+\frac{0.30}{0.17}0.109\right)\div 4+ \\ & +\left(\frac{114.8}{15.3}0.058+\frac{114.8}{23.3}0.255+\frac{114.8}{21.5}0.562+\frac{114.8}{77.2}0.109\right)\div 4+ \\ & +\left(\frac{0.114}{0.012}0.058+\frac{0.114}{0.0117}0.015+\frac{0.114}{0.0124}0.562+\frac{0.114}{0.0107}0.109\right)\div 4+ \\ & +\left(\frac{0.002}{0.002}0.015+\frac{0.002}{0.001}0.255+\frac{0.002}{0.002}0.562+\frac{0.002}{0.001}0.109\right)\div 4= \\ & =1.135+1.419+0.351+1.214+0.209+0.315=4.643. \end{aligned} \tag{5}$$

Table 9

Matrix of the development potential of agricultural enterprises in the Rostov region in the context of legal forms

Characteristic	PJSC	NJSC	LLC	APC
Marketable output per 100 ha of agricultural land, thousand USD	0.474	0.460	0.471	1.135
Profit per 100 ha of agricultural land, thousand USD	0.362	0.523	0.730	1.419
Production profitability, %	0.507	0.338	0.791	0.351
Capital-labour ratio, thousand USD /100 ha	0.468	0.501	0.436	1.214
Capital productivity ratio, USD	0.481	0.199	0.354	0.209
Return on assets, USD	0.572	0.221	0.495	0.315
Integrated index	2.864	2.242	3.277	4.643

Source: developed by the authors.

The data in Table 9 indicate that the potential for enhancing the production of marketable products per 100 ha of agricultural land, profit per100 ha of agricultural land, and capital-labour ratio was greatest in agricultural production cooperatives.

The first step in determining the optimal production pattern in agriculture and increasing yield and production in an area was to identify and evaluate the production capacity of agricultural farms, which can create an important political and economic situation. The increase in production capacity shown in the region also predicts high production efficiency in the region.

Achieving sustainable agricultural growth is one of the key issues that can be achieved with high profits by producing products in agricultural companies. Creating such growth is linked to governments' desire for the alleviation of poverty, the need to regulate the supply of sufficient produce, and attention to the key role that the agricultural sector can play in the comprehensive economic development of countries.

4. DISCUSSION

Analysis of the main production and economic indicators of the eight clusters of public joint-stock companies showed that the largest cluster (Cluster 7), included 17 farms that were characterised by poor agricultural performance indices in comparison with the other clusters.

Eight highly profitable public joint-stock companies formed Clusters 3 and 6. Their profitability was two times higher than the overall average of the eight segments obtained. The highest performance of fixed assets was observed in Clusters 4, 6 and 8.

PJSC "Taganrog Poultry Farm" had the greatest indices and formed Cluster 8. This enterprise demonstrated large production and high availability of fixed assets, however profitability was 1.9 times lower than the average value of other clusters of public joint-stock companies (Table 2). Hierarchical clustering was taken into account when applying the K-means method and allowed to characterise the public joint-stock companies of the Rostov region as entities with individual features that did not allow them to be included into one of the clusters, despite their small number in the Rostov region (Bogoviz et al. 2017). The authors believe that clustering enterprises of one legal form enables not only forming segments of economic entities similar in a number of characteristics, but also identifies the potential of the analysed business form on this basis (Kononova, Fedulova, 2018).

According to research, one of the main factors in improving economic efficiency is the corporate governance system, which includes a set of relations between the company's management, board of directors, shareholders and other stakeholders.The company management system provides a structure through which the company's goals are set and the means to achieve the goals and performance monitoring are determined (Smirnova, 2016; Bogoviz et al., 2019).

Additionally, Veselovsky et al. (2018) examined two criteria of corporate governance and their relationship with the market value of the company and found that in companies with weak governance, every $1 change in cash flow will cause

a change in market value of about $0.42 to $0.88. This amount is doubled up in well-governed companies.

Epstein et al. (2018) found that there is a relationship between corporate governance and corporate performance. Using time series and regression, it was shown that there was a strong positive relationship between the size of the board of directors and stock market value.

Rodionova et al. (2017) concluded that better management leads to better corporate governance and paying more attention to their stakeholders, and that corporate value is positively related with corporate governance.

Ibragimov et al. (2013) examined the effect of ownership structure on company performance. The results of their research show that there is an important and positive relation between the ownership structure and the performance of the company.

As seen in Figure 5, non-public joint-stock companies analysed according to the proposed method showed the integral indicator of potential growth of 2.242. As seen in Figure 8, most of the indices were different; close proximities were most influenced by similar numbers of employees, labour remuneration fund, and land area which is consistent with the results of Kholodov (2019).

In general, the clustering of agricultural production cooperatives indicated that there is moderate variation in the performance indicators of enterprises within clusters. This is in agreement with Gurnovich et al. (2017).

As shown in Table 9, the profitability potential dominates in LLCs and the opportunity to enhance the efficiency of fixed assets is greatest in public joint-stock companies. In general, by improving the business mechanism, activating intra-economic resources, and having an adequate system of distribution relations, agricultural production cooperatives have the greatest opportunities to increase the basic production and economic indices in comparison with other organizational and legal forms (Table 9).

According to the theories of production and supply, the growth of production of agricultural companies is achieved in two ways. In the first, increasing production by using more production factors, but within the existing technology is provided. In the second one, the main and major contribution in increasing production is obtained by using more advanced and efficient methods of production and using effective production factors (Altukhov and Rassadin, 2012; Sidorova and Shamin, 2014; Hutorov et al., 2019).

In the agricultural sector, development is not possible without technology. With the development of technology in agriculture, in addition to replacing imported products in this field, one can be creative in the production of domestic products and increase the added value of agricultural products without intermediaries (Bragin and Bolshakova, 2015; Petrikov et al., 2016).

Changing the technology of agricultural production in the economy is one of the important sources of production growth, not only on the supply side but also on the demand side of the economy, because changing technology and technology in each

economic sector leads to substitution among production inputs. This substitution can affect the production of other sectors through post-growth effects (Zhakhov and Sirotkina, 2018; Balashov and Shelkovnikov, 2019).

The technology of producing a product determines how the inputs are combined to produce it. Therefore, applying technology and technology in the production is a change in the production process of that product. This change can lead to the production of a fixed level of goods using a lower amount of inputs or the production of a higher level of the product with the same amount of previous inputs. Therefore, using the potential of technology change can be one of the sources of production growth and improving the performance of economic indicators of agricultural enterprises (Bogoviz and Butorin, 2019).

As one can see, the potential for increased production of marketable products in the presented study increased, which increased profits. Rakotonirin and Cheng (2015) stated that the profitability of agricultural activities is an important factor in attracting capital and credit to this sector. They argued that among agricultural activities, facilities and credit should lead to more lucrative opportunities to increase farmers' incomes. Therefore, the agricultural sector needs to implement factors to provide profitable investment opportunities by increasing the production potential for investors.

As seen from the results, the production index and capital ratio increased. Hassan Prince Annor (2017) stated that the policy of development and expansion of the agricultural sector in terms of production and increase in profits from income plays a very important role in the development of the country. The activities of the agricultural sector, due to their practical nature and their role in reducing the income gap and more equitable distribution of income than other economic sectors, not only can help increase national security by reducing dependence on food imports but also prevent currency outflows. From the perspective of economic and social variables such as increasing employment and reducing poverty, they are more capable and efficient than other sectors and should be considered by policy makers.

CONCLUSIONS

The results presented here revealed a differentiation in the values of the main production and economic indices of agricultural enterprises in the Rostov region within each legal form. Considering that the enterprises under study all operated under equal legal conditions, the authors can state that there is an opportunity to improve the performance indices of enterprises of the four business forms investigated. Additionally, the main effects of the study showed that the potential for enhancing the production of marketable products per 100 ha of agricultural land, profit per 100 ha of agricultural land, and capital-labour ratio is greatest in agricultural production cooperatives. The main factor in increasing the performance of agricultural enterprises, however, is probably the improvement of intra-economic relations that should leverage all the hidden potential of production, technology, and finance.

REFERENCES

Altukhov, I.A., Rassadin, D.M. (2015). The effectiveness of legal forms in agriculture. *Economics of Agriculture of Russia*,1, 34-37.

Balashov, A.P., Shelkovnikov, S.A. (2019). Profit as the main source of development of agricultural organizations. *Ekonomika Sel'skokhozyaistvennykh i Pererabatyvayushchikh Predpriyatii*, 5, 36-40.

Bogoviz, A.V., Romantsova, T.V., Galenko, N.N., Rykhtikova, N.A., Suglobov, A.E. (2019). Cluster mechanism of marketing optimization on the basis of systemic interaction between the Internet of Things and social networks. In: Ubiquitous computing and the internet of things: prerequisites for the development of ICT (pp. 925-931). Springer, Cham.

Bogoviz, A.V., Vorobyov, S.P., Vorobyeva, V.V. (2017). The influence of the legal form of agricultural organizations on the effectiveness of their functioning. *Economics of Agriculture of Russia*, 3, 18-23.

Bragin, N.I., Bolshakova, Y.Y. (2015). Business and legal forms of agricultural organizations of the Kemerovo region and the effectiveness of their industrial and economic activities. *Bulletin of Altai State Agriculture University*, 8(130), 144-148.

Butorin, S.N., Bogoviz, A.V. (2019). The innovation and production approach to management of economic subjects of the agrarian sector. *Advanced Intelligent System and Computer*, 762, 758-773.

De Silva,P.H.G.J., Sandika, A.L. (2012). The impact of agricultural credit and farmer training on smallholder dairy production in the southern region in Sri Lanka. *Iranian Journal of Applied Animal Science*, 2(3), 265-269.

Epstein, D., Curtís, J., Gagalyuk, T., Unai Gailhard, I. (2018). The recoverability of agricultural organizations and influence of various factors and integration processes on it (in North-West Russia). *Agro-Industrial Companies Economics and Management*, 4, 4-20.

Gurnovich, T.G., Agarkova, L.V., Ostapenko, E.A.,Usenko, L.N. (2017). Increasing competitiveness of the agrarian sector of the regional Russian economy. *International Journal of Engineering and Technology*,7(4), 201-211.

Hutorov, A.O., Hutorova, O.O., Lupenko, Y.O., Yermolenko, O.A.,Voronko-Nevidnycha, T.V. (2019). Modeling of the cycle of reproduction process in the agrarian sector of the economy. *Revista Espacios*, 40(7), 19-21.

Ibragimov, A.K., Gurov, V.I., Mikhailova, O.V., Vanin, Y.D. (2013). Improvement of intraeconomic economic relations of agricultural enterprises of various legal forms. *Bulletin of Kursk State Agricultural Academy,*1, 40-43.

Kholodov, O.A. (2019). Efficiency and potential of legal forms in agriculture. *Agricultural Bulletin of Urals*, 10(189), 93-102.

Kononova, S.A., Fedulova, E.A. (2018). Algorithm for applying a balanced scorecard to evaluate the performance of an agricultural organization. *Ekonomika Sel'skokhozyaistvennykh i Pererabatyvayushchikh Predpriyatii*, 1, 12-17.

Makin, G.I. (1998). Agro-industrial complex management system in the transition period. Agri Press, Moscow, Russia, pp. 175.

Mengistu, D.W., Wondimagegn, K.A., Demisash, M.H. (2017). Reproductive performance evaluation of Holstein Friesian and their crosses with Boran cattle breeds in the Ardaita Agricultural Technical Vocational Education Training College dairy farm, Oromia region, Ethiopia. *Iranian Journal of Applied Animal Science*, 6(4), 805-814.

Monden, Y. (1989). Methods of effective management. Economics, Moscow, Russia, pp. 110.

Petrikov, A., Gataulina, E., Saraikin, V. (2016). Dynamics and comparative effectiveness of agricultural organizations in Russia of various legal forms. *Mezhdunarodnyĭ Sel'skokhozyaĭstvennyĭ Zhurnal*, 6, 9-15.

Poorghasemi, M., Chamani, M., Mirhosseini, S.Z., Sadeghi, A.A., Seidavi, A. (2017). Effect of probiotic and different sources of fat on performance, carcasscharacteristics, intestinal morphology and ghrelin gene expression on broiler chickens. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, 24(2), 169-178.

Poorghasemi, M., Seidavi, A.R., Qotbi, A.A.A. (2013). Investigation on fat source effects on broiler chickens performance. *Research Journal of Biotechnology*, 8(1), 78-82.

Poorghasemi, M., Seidavi, A.R., Qotbi, A.A.A., Chambers, J.R., Laudadio, V., Tufarelli, V. (2015). Effect of dietary fat source on humoral immunity response of broiler chickens. *European Poultry Science*,79, 1-8.

Prince Annor, B. (2017). Global GAP standard compliance and profitability: A case study of smallholder pineapple farmers in the Akuapem South of Ghana. *International Journal of Agricultural Management and Development*, 7(2), 165-177.

Rakotonirin, J., Cheng, J. (2015). Research on the impacts of rural-to-urban migration on demographic characteristics regarding economic development in Madagascar. *American Journal of Industrial and Business Management*, 5, 335-350.

Rodionova, O., Golosina, L., Logacheva, O. (2017). Expert assessment of economic relations and the effectiveness of agricultural organizations. *Economics of Agriculture of Russia*, 11, 2-9.

Shepitko, R.S., Dugina, T.A., Nemchenko, A.V., Likholetov, E.A. (2015). A multi-factorial vector for the development of agriculture in a region. *Regional Economics*, 4, 275-288.

Sidorova, N.P., Shamin, A.A. (2014). Analysis of the efficiency factors of agricultural enterprises of various legal forms.

Vestnik of Volga State University of Technology Economics and Management, 5(24), 67-77.

Smagin, B.I. (2002). On the question of the methodology for determining the integral indicator of production efficiency. *Ekonomika Sel'skokhozyaistvennykh i Pererabatyvayushchikh Predpriyatii*, 7, 18-21.

Smirnova, I.V. (2016). The effectiveness of the management of reproduction processes in agricultural enterprises of various legal forms. *Acta Economics of Modern Russia*, 3, 91-94.

Sugiharto, S., Yudiarti, T., Isroli, I.,Widiastuti, E. (2018). The potential of tropical agro-industrial by-products as a functional feed for poultry. *Iranian Journal of Applied Animal Science*, 8(3), 375-385.

Usenko, L.N., Chernysheva, Y.G., Guzey, V.A., Todorova, O.M., Usenko, A.M. (2017). Problems and perspectives of cluster formation in view of the sustainability of the development of regional business structures of the Russian Federation. *International Journal of Trade and Global Marketing*, 2, 160-167.

Veselovsky, M.Y., Izmailova, M.A., Bogoviz, A.V., Lobova, S.V., Alekseev, A.N. (2018). Innovative solutions for improving the quality of corporate governance in Russian companies. *Calitatea*, 19(162), 60-66.

Zhakhov N.V., Sirotkina N.V. (2018). The problem of systemic development of the agrarian sector of the region's economy. *Science Delta*, 1, 115-119.

Received: January 2021, revised: October 2021

Acknowledgements: *The authors are grateful to the Russian Science Foundation for the financial support of scientific research under project 22-16-00041 NIIMMMP.*