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AGRICULTURE CLUSTER IMPLEMENTATION IN A PRODUCTION SYSTEM

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Abstract
The clustering mechanism is applied in the production of agricultural products of Kashkadarya region. In clustering, using economic mathematical methods, cluster analysis and forecasting options have been developed.
Keywords: Cluster, economic entities, interregional clustering, econometric modeling, digital technology, empirical model, econometric model, potential, relative model, forecast results, information system, endogenous variables, exogenous variables.

Introduction.
To ensure the sustainable development of agriculture in the world, to determine the optimal ratio of efficient use of resources, to have optimal solutions using econometric methods in the development of product production and organization of management, to ensure the food security of the population based on the development of future forecast indicators of agricultural production special importance is given to research works.
Special attention is being paid to modern methods of agricultural management, ensuring food safety by introducing new technologies at the stages of production, and the well-being of rural residents in the establishment of a new Uzbekistan. In the Action Strategy for the five priority directions of the development of the Republic of Uzbekistan in 2017-2021, "modernization and rapid development of agriculture, in particular, deepening structural changes and consistent development of agricultural production, further strengthening the country's food security, expanding the production of environmentally friendly products, A number of tasks have been set, such as significantly increasing the export potential of the agricultural sector"[1].
Currently, promising agricultural projects are implemented more in the clustering system. Clusters are becoming the main production entities that develop the agriculture of our country. This is considered as one of the serious steps in the reform of agriculture in the new Uzbekistan. If we pay attention to the numbers, 651 agroclusters are operating in all directions. 100 percent of cotton and grain production, and more than 40 percent of fruit and vegetable production,

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which are the main areas of agriculture, are accounted for by cluster enterprises. Production activities of the clusters are carried out on 2.2 million hectares of agricultural land.

Research methods

Theoretical and practical issues of effective use of land and other resources of production in agriculture rely on several field knowledge. An agrarian approach alone does not offer any solution. In the opinion of Max Weber[2], a research scientist who conducted scientific research in the agrarian field, in the future, the result cannot be achieved only by improving the quality of the land resource, increasing the efficiency of labor resources, but it will be possible to achieve the increase in the volume of production only by using intellectual technologies.

The Dutch researcher Jaap Jan Schröder[3] emphasizes the increasing role of the chemical industry in agricultural production. Researcher Dunstan Gabriel Msuya[4] in his scientific studies on the Canadian agricultural system states that the development of genetic engineering is one of the main factors determining the development of agriculture.

In the world experience, a number of issues have been systematically studied in the process of modeling the development and management of agricultural production[5].

The scientific basis for the advantages of the cluster system is presented in the scientific works of academician Clayton Christensen[6]. He enriches the cluster system and innovation theory in his scientific researches in entrepreneurship and investor activities. Describes the principles of cluster implementation in the production system.

The importance of such a cluster approach in the development of agriculture is that it is not enough to observe a specific economic process in the network to make a final decision when analyzing existing problems and their causes. For example, the production function is used in the studies of the agricultural sector at the national level. In this case, they limit themselves to drawing primary conclusions based on the model built on labor resources and capital expenditure from the production function in the form of Cobb-Douglas [7].

In the case of clustering, the organization of agricultural production begins with planning. The planning stage represents the introduction of production activities and is of great importance in increasing production efficiency. Requirements are set in planning. The basic potential of the manufacturer is analyzed. It is necessary to plan based on a number of scenarios and determine the most optimal among them. This process is related to the concept of optimization. Researchers Akhil Varma, University of Cambridge; Ajith S. Nath; V Regikumar [8] investigated the evaluation of agricultural production optimization models using a large number of simulations.

Russian economist Yugai A.M.[9] In his studies, he notes that repeated cropping and crop rotation in the Russian Federation had a great impact on the volume of production. Also, by the scientists of our country, the efficiency of land use in the region [10], and the use of modeling in assessing the value of land resources were considered.

The issue of optimizing the production of agricultural products is presented in scientific studies[11] as setting criteria for reducing resource consumption and increasing production volume in relation to resource limitations. The search for optimal production options in agriculture usually goes back to resource provision[12]. Assessment of the efficiency of resource use, planning of optimal production based on their management is not sufficiently improved today. In our opinion, one of the reasons for this is the necessary approach in econometric modeling, such as that the computational processes should not be too complicated when choosing methods for solving the problem.

The most common harmonic analysis and less commonly used spectral analysis methods can be used to conclude the sustainable development of agriculture based on the observation of a certain periodical repetition of the reality occurring in the field.[13] Harmonic and spectral analysis is one of the methods of researching technological processes, and it is used to determine the quality of the system pulse signal, and to determine the periodic or non-periodic signals of the complex dynamic system.

Russian economist A.F. According to Patskalev[14], the concept of production potential should include the maximum possible final result of the development of the agro-industrial complex and its structural links. It can be concluded from this opinion, that is, taking into account the nature of the influence of resources on the volume of production, the production potential of agricultural production is determined not by a mechanical set of individual resources, but by their system, in which the interdependence of all elements is clearly manifested.

The need to solve problems related to the development of agriculture, improvement of production in terms of quantity and quality can be justified by the importance of meeting the primary needs of society. Therefore, it is considered as one of the characteristics of this sector different from economic sectors. The agrarian industry is distinguished from other sectors of the economy by its use of material resources, permanent relationship with living organisms, demographic situation, existence of labor and social infrastructure [15].

The Food and Agriculture Organization of the United Nations (FAO) predicts that agricultural land per capita will decrease rapidly as the world's population increases. In this regard, in order to provide food for the growing world population, farmers will have to continuously produce one and a half times more crops by 2050[16].

Issues such as increasing the efficiency of the use of land resources in agriculture, minimizing the cost of limited resources are brought to the simplex method, technical and technological means supply issues are brought to the issue of transport [17].

The only goal of all the above-mentioned researches is to increase the production of agricultural products in terms of quality and quantity, to satisfy the demand of the population of our republic for food products, and to replenish the food resource mainly at the expense of domestic capabilities. It can be said that today the provision of food products at the level of scientifically based consumption standards of citizens is not fully implemented. In addition, the composition of people's daily diet does not fully meet the requirements.

Result and discussion

As a result, meeting the growing need, providing food at the level of the established standards remains one of the important problems awaiting its solution. It is one of the problems faced by the low-income population living in rural areas.

The main reason for this is the low level of development of production forces in the agrarian sector, disparity between sectors, low production efficiency in agriculture, insufficient financial resources, means of production and weapons[18]. We cite the views of foreign scientists on this problem, that is, they show that the economic forms in agriculture are not fully reformed, enterprises in the field do not have optimal dimensions, effective methods of production are not used, as well as methodological foundations for social protection of the population are not fully formed[19] they admit.

Also, special attention should be paid to researching the production process based on accurate quantitative methods and determining optimal options. In particular, it is required to study the process of economic growth using production functions.

Because agriculture is under the influence of many factors and is a very complex system [20]. Therefore, it is impossible to create a mathematical description for the QXMICh process, to analytically express all the dependencies.

Taking into account the above-mentioned conclusions, the main goal of the agricultural reforms is to ensure the abundance of the country's table, to meet the needs of the population for agricultural products.

One of the important tasks of the reforms in this direction is to transfer the land to its owner. As we all know, improving production and management in agriculture, introducing digital technologies to it based on today's requirements is not an easy and smooth process. This, in turn, creates shortcomings and problems that need to be solved in the regions.

In our opinion, the formation of agriculture based on digital technologies provides a solution to the problems. In addition, it is desirable to create legal conditions that ensure the full economic and financial independence of farms and encourage the purposeful, rational and effective use of agricultural land resources that have been leased for a long time.

Special attention is being paid to modern methods of agricultural management, ensuring food safety by introducing new technologies at the stages of product production, and the well-being of rural residents in the establishment of a new Uzbekistan. In the Action Strategy for the five priority directions of the development of the Republic of Uzbekistan in 2017-2021, "modernization and rapid development of agriculture, in particular, deepening structural changes and consistent development of agricultural production, further strengthening the country's food security, expanding the production of environmentally friendly products, A number of tasks have been set, such as significantly increasing the export potential of the agricultural sector"[2]. also Within the framework of the priority tasks set in the Development Strategy for 2022-2026, rapid development of the national economy and ensuring high growth rates, in particular, increasing the income of peasants and farmers by at least 2 times, bringing the annual growth of agriculture to at least 5%, fundamentally reforming the water resources management system and it is planned to implement a separate state program on water conservation, expand the fodder base and increase the production volume by 1.5-2 times, develop fruit and vegetable cultivation, increase the area of intensive gardens by 3 times and greenhouses by 2 times, and increase the export potential to 1 billion dollars [22]. As a result, modern research methods in the development and management of production of agricultural products,

One of the main problems in determining the agricultural production potential of the region is the large number of production facilities that embody the production complex. In this case, it is possible to solve the problem by summarizing the objects that are less differentiated by certain indicators and creating a group of objects. Then the clustering method can be used. For this, cluster analysis is conducted.

Economic and social efficiency of clusters and their members:

- new manufacturers from other industries develop their R&D activities and strategies to retain new ones, so they accelerate development;
- mutual free exchange of information appears, news spreads between consumers and suppliers through channels;
- mutual competition creates new opportunities;
- new opportunities for human capital, scientific ideas are introduced into development and production[23].

According to the results of the research, agricultural production and its management is a very complex process that takes place under the influence of many factors, and the use of econometric models in its research, the use of the cluster method, serves to obtain clear and targeted results and conclusions. In particular, it helps to meet the high need for the results of econometric analysis in the development of ways to identify and eliminate seasonal fluctuations.

In cluster analysis, the following approach is distinguished by its importance today, that is, the indicators of resource availability per unit area and the absolute size of resources should be taken as a basis for clustering[24], as well as the production function of the gross product volume (Y) for each cluster depending on the amount of resources consumed will be built.

For the production function built on the production potential, the coefficients defined for each resource are required to be non-negative. Because an increase in the price of any type of resources is proportional to a slight increase in the volume of manufactured products.

Based on the above, on the example of Kashkadarya region, the following proposals were developed for the development of agricultural production and systematization of modeling (Table 1).

Table 1

Proposals for development of production of agricultural products, systematization of management

Offers	Features and amenities	Obstacles
Expanding the scope of use of resource-saving technologies	Possibility of local organization of resource-saving tools; Experience of manufacturers; State support	Unpopularity of innovative technologies; Local resource-saving tools are not at the required level; Cost of imported products;

Strengthening multi-sectoral activities in farms, including animal husbandry	The size of land areas; Sufficient cocktail resources; The possibility of self-financing; Ability to operate in a cluster system State support	The intensity of external influences on agricultural activity; That the land does not belong to the real owner; Lack of breeding practices; Dissatisfaction with digital transformation
Strengthening multi-sectoral activities in farms, including medicinal plants	Quality land areas; The labor resource is sufficient; Low labor and production costs; State support	Lack of experience; Export problems; Dissatisfaction with digital transformation Lack of systematic organization of production
Development of greenhouse economy in households	Climate of the territory; In villages and cities, the farm lands are used only seasonally, and remain vacant during the rest of the year; The relatively good quality of farm lands; State support	Low heat supply in rural areas, high cost of greenhouse building materials, lack of equipment with digital sensors, insufficient skills of workers
Expansion of production specialization	Convenient geographical location; Production experience; State support	That a healthy competitive environment does not depend on the production of commodity products; Lack of investment appeal
Improvement of equipment supply and rental system	Availability of all types of technical means	Lack of multifunctional techniques; High cost of equipment; Lack of systematic use of technical service; Insatisfaction of Internet platforms for rent; Uneven distribution of technical support in districts

Formation of digital infrastructure	Popularization of mobile communication tools; Availability of internet service in the territories; ICT literacy of the population	Unpopularity of digital technologies; Cost of digital technologies and services; Technologies are imported products; Inadequate skills and qualifications of field workers; The imperfection of electronic platforms and the lack of users

In the conditions of new Uzbekistan, the agricultural service system will be closely connected with such important areas as irrigation, land reclamation, breeding. After all, it is impossible to imagine Uzbekistan's agriculture without high-level development of these sectors.

There are several methods for cluster analysis, and it is important to choose the right clustering method so that the results of the analysis do not have a negative impact on future calculations. In this regard, we conduct a cluster analysis using Ward's method. According to the essence of this method, initially each cluster is assumed to consist of one object. After that, the two closest clusters are merged. For them, the average values of each resource are determined and the sum of the squares of the deviations is calculated. The cluster structure is formed based on the evaluation of the total value. Here, the advantage of Ward's method is that, despite the fact that indicators are viewed for several different resources, the clustering step is not increased.

Based on this method, we perform cluster analysis using the Statistica 26 program and obtain the following results.

Table 2.

Agglomeration order calculated using Statistica26 package

Agglomeration order (clusters)						
Step by step	Merge clusters		Coefficients	Stage 1 of cluster formation		The next stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	6	10	1672.2840000	0	0	2
2	3	6	6509.6260000	0	1	9
3	7	9	26919.942000	0	0	4
4	7	12	57554,527000	3	0	7
5	4	5	126564.74400	0	0	9
6	2	8	202536.14000	0	0	12
7	1	7	296138.67400	0	4	8
8	1	13	528514.72800	7	0	10
9	3	4	858057.26900	2	5	11
10	1	11	3199325.6680	8	0	11

11	1	3	7927309,7700	10	9	12
12	1	2	20471452,186	11	6	0

Here, the agglomeration coefficients were calculated by dividing the number of producing subjects and the average values of the shortest distances between the territories of the agromelioration subjects by the area size of the agromelioration area. According to the results of the determined dendogram, there are a total of four clusters (Figure 3.2.1), respectively, we write the clusters as follows: Cluster 1: (6,10,3,4,5); Cluster 2: (7,9,12,1,13), Cluster 3:(1,11), Cluster 4: (2,8).

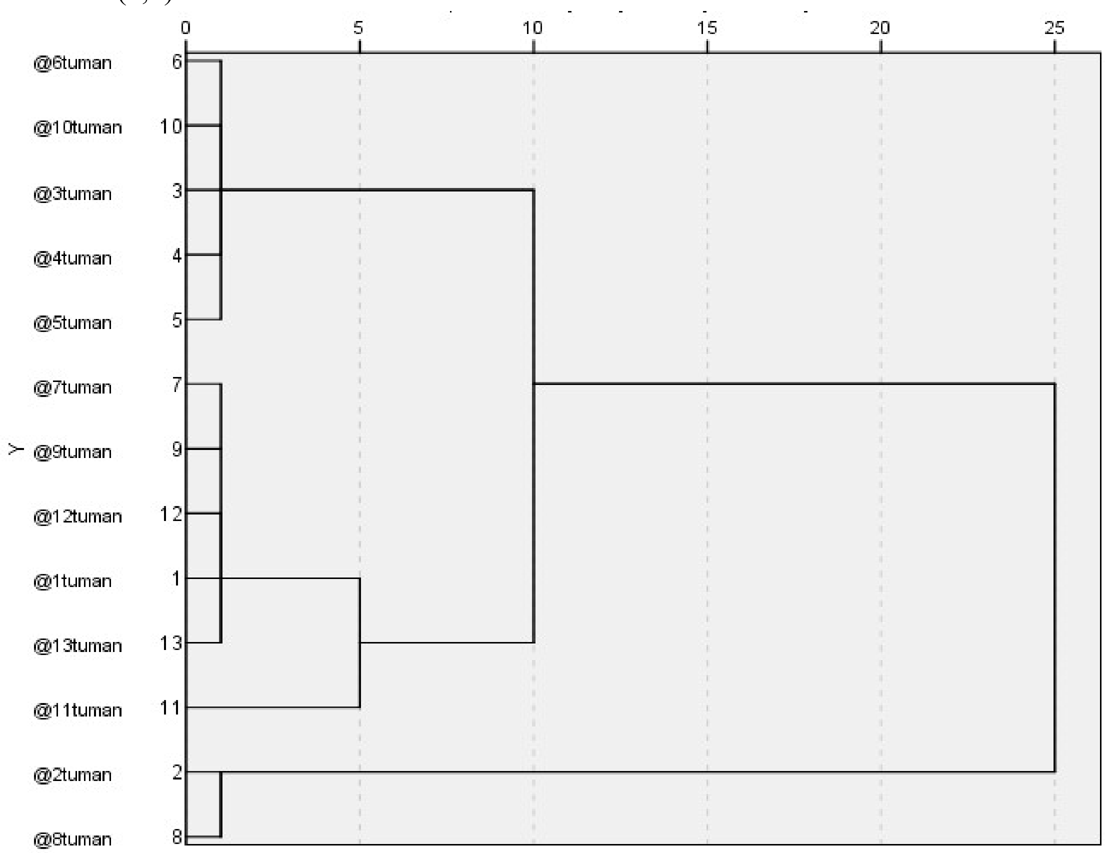

Figure 3.2.1. A dendogram made using Ward's method

It can be seen that cluster 1 includes Kitab district, Karshi district, Kasbi district, Koson and Qamashi districts, cluster 2 includes Mirishkor, Nishon, Shahrisabz, Guzor and Yakkabog districts, cluster 3 includes Guzor and Chirakchi districts, cluster 4 includes Dehkanabad and Mubarak districts.

When analyzed by the average value of the indicators for each cluster, cluster 1 is the highest in terms of the number of workers per 100 hectares of land, the value of fixed assets per 100 hectares of land, and the working capital per 100 hectares of land at the disposal of agricultural producers. total land area and working capital have the lowest indicators. Similarly, cluster 4 is distinguished by the high annual value of primary production funds.

Table 3.

Average values of indicators of clusters by production resources

Indicators	Clusters			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
P1	39.54	30.62	43.95	33.6
P2	107.54	134.36	250.55	286.15
P3	17.44	12.94	25.4	12.85
P4	3563.2	3702.6	5271.5	6825.5
P5	330	343	474.5	632
P6	2130.8	1308.8	2294.5	1108
P7	18	10.6	10,15	4.45
P8	4,214	2,776	1,495	2,385
P9	0.392	0.256	0.14	0.22

We define the kinetic production function for each cluster [25]. We use the statistics of the following factors for the last ten years.

X1 – total land area at the disposal of agricultural producers (thousand ha); X2 – annual average number of workers (thousands of people); X3 – annual value of the main production funds (billion soums); X4 – annual working capital (billion soums);

We define the production function for cluster 1. For this, we take the average of the indicators based on the general statistical data of the resources for the districts included in the 1st cluster (Table 4).

Table 4.

Factor score for cluster 1 kinetic production function

X1	X2	X3	X4	ln(x1)	ln(x2)	ln(x3)	ln(x4)	ln(y)
102.86	15.98	637,1912	58.29837	4.633369	2.771338	6.45707	4.065574	5.951788
103.06	16.54	818.0562	74.21	4.635311	2.805782	6.706931	4.306899	6.197869
411.46	17,14	952,371	86.93511	6.019712	2.841415	6.858955	4.465162	6.349034
104.56	18,14	1155,796	103,394	4.649761	2.898119	7.052545	4.638547	6.523797
105.12	19.34	1364,927	123.7172	4.655103	2.962175	7.218856	4.817998	6.706006
105.74	19.66	1627,514	148,2029	4.660983	2.978586	7.394809	4.998583	6.888042
106.4	20.36	2170,896	200.5476	4.667206	3.013572	7.682895	5.301052	7.181835
106.72	20.88	2683.26	242,1811	4.670209	3.038792	7.894788	5.489686	7.380829
107.04	21.4	3005,553	277.4428	4.673203	3.063391	8.008217	5.625615	7.50286

107.54	21,872	3563,29 6	329,934	4.67786 3	3.08520 7	8.17844 1	5.79889 3	7.66419 6

The presence of a high degree of correlation between these factors prevents them from being included in the model at the same time, so we consider their effects separately[26]. As a result, we build the following empirical models.

Table 5

Functions developed to estimate the impact of resources on production volume for cluster 1

No	model	Student criteria	Coefficient of determination
1	$lnY = 2{,}32 * lnX_2$	b1 =64.66	0.99
3	$lnY = -0.51 + 1{,}0 * lnX_3$	b0=-15.18 b1 =217.5	0.99
4	$lnY = 1.92 + 0{,}99 * lnX_4$	b0=101.6 b1 =261.2	0.99

The coefficients of determination of the models are very high, and each coefficient is adequate according to the Student's criterion, here we did not pay special attention to Fisher's criterion, because it is not needed in a one-factor function.

The following can be said about the built models:

- the relationship between the change of agricultural land and the volume of gross product production was not determined, the reason for this is that the change of the product volume in the next period is provided at the expense of intensive factors;
- a 1% increase in the number of workers leads to a 2.32% increase in the volume of gross product production;
- a 1% increase in the amount of fixed assets leads to a 1% change in the volume of gross product production;
- a 1% increase in the amount of working capital leads to a change in the volume of gross product production with a regularity of 0.99.

Here, the highest elasticity index belongs to the resource x2, which justifies the fact that agriculture is the most labor intensive. On the other hand, if we take into account that agriculture is an important sector in providing employment, this situation can be accepted as natural.

We determine the production function for cluster 2 by taking the average of indicators (Table 6) on the basis of the general statistical data of resources for the years 2011-2020 for the districts that make up cluster 2.

Table 6.

Factor indicator for cluster 2 kinetic production function

X1	X2	X3	X4	ln(x1)	ln(x2)	ln(x3)	ln(x4)	ln(y)
176.9 2	16.44	953.286 2	88,757	5.17569 8	2.79971 7	6.85991 5	4.48590 2	5.79252 6

173.86	17	1184,814	108.3618	5.15825	2.833213	7.077341	4.685476	6.016547
175.66	17.88	1395,544	129.3882	5.16855	2.883683	7.24104	4.862817	6.173119
176.9	18.54	1660,385	155.0036	5.175585	2.919931	7.414805	5.043448	6.343775
177.74	19.2	1900,137	177.7286	5.180322	2.95491	7.549681	5.180258	6.481608
178.66	19.64	2138.75	206.9842	5.185485	2.977568	7.667977	5.332642	6.635448
180.48	19,972	2912,834	270.3215	5.19562	2.994331	7.976882	5.599612	6.908855
181.78	20,298	3358,418	311,1083	5.202797	3.010522	8.119225	5.740141	7.055572
183.24	20,642	3913,206	366,3513	5.210797	3.027328	8.272112	5.903593	7.209444
184.36	20,898	4715,272	436.6	5.21689	3.039653	8.458562	6.079017	7.382187

Table 7

Functions developed to estimate the impact of resources on production volume for cluster 2

No	model	Student criteria	Coefficient of determination
1	$lnY = 1,27 * lnX_1$	b1 =41.03	0.99
2	$lnY = 2,24 * lnX_2$	b1 =59.07	0.99
3	$lnY = -1.05 + 0,99 * lnX_3$	b0=-17.41 b1 =217.3	0.99
4	$lnY = 1.33 + 0,99 * lnX_4$	b0=43.44 b1 =172.1	0.99

From the data in the table, we can see that the model is adequate according to the given criteria, the coefficients of determination have a high value. The analysis using these models is based on the fact that conclusions can be drawn. Taking this into account, the following conclusions can be drawn based on the results of the developed models:
- Unlike the first cluster, there is a high correlation between the land area and the volume of gross product production, besides, the coefficient of elasticity between both indicators is getting a high value. That is, a one percent increase in land area ensures an increase in gross product volume by 1.27 percent;
- the coefficient of elasticity of the volume of gross product production in terms of the number of labor force has almost the same value as the indicator in the first cluster and remains the highest indicator;
- the coefficient of elasticity for the amount of fixed assets and working capital remains almost

equal to the value in the first cluster.

We did not find it permissible to pay special attention to the production functions for cluster 3, because the obtained results are almost the same as the results obtained for cluster 2.

To determine the kinetic production function for cluster 4, we write equation (1.2.8) in the following form. Here, the statistical values of resources are presented in Table 8.

Table 8

Functions developed to estimate the impact of resources on production volume for cluster 4

No	model	Student criteria	Coefficient of determination
1	$lnY = 1{,}08 * lnX_1$	b1 =32.25	0.99
2	$lnY = 2{,}26 * lnX_2$	b1 =50.01	0.99
3	$lnY = -1.78 + 0{,}99 * lnX_3$	b0=-52.86 b1 =234.0	0.99
4	$lnY = 0.59 + 0{,}99 * lnX_4$	b0=24.29 b1 =223.5	0.99

According to the results of cluster 4, the main difference is observed between the land area and the volume of gross product production, that is, the coefficient of elasticity is slightly decreased.

Thus, the results of the analysis of production functions and elasticity coefficients for all clusters are as follows.

1) The efficiency of agricultural land use has an average indicator, and only in cluster 4 the optimal amount of land resources is 281 thousand hectares, and the efficiency is below average.

2) Efficiency of use of labor resources has an average indicator, and in all cases the coefficient of elasticity is greater than 2. It can be seen that the use of labor remains more efficient than capital in all clusters. The main reason for this is the relatively cheap labor force.

3) The index of effective use of the main production fund resource has an average value in all clusters, and the elasticity coefficient is one, which means that a one percent increase in the amount of funds leads to a one percent increase in the gross product.

4) The same situation can be observed in terms of the efficiency of using annual working capital, that is, the coefficient of elasticity is 0.99. Based on the obtained results, we evaluate the indicators of effective use of resources in the process of production of agricultural products of the region.

Table 9.

Assessment of indicators of effective use of resources in the process of production of regional agricultural products

Indicators	Clusters			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
X1	no correlation found	high	high	Average
X2	high	high	high	High

X3	average	average	average	Average
X4	average	average	average	Average

The following conclusions can be drawn from the analysis of production functions for all clusters.

- efficiency of use of land resources is average, excluding the first cluster;
- the efficiency of the use of labor resources is at a high level, which has a great impact on the volume of production;
- the efficiency of using the main production funds is medium;
- the efficiency of using working capital is medium;

Consclusion

If we analyze the level of utilization of the available production potential in the region based on the results[27], it was found that it is not being used sufficiently. In this case, it is necessary to increase the efficiency of the use of land resources and working capital. Because the influence of these factors on the volume of gross product remains somewhat low. That is, extensive growth prevails in the production of agricultural products in the region, but in today's conditions, attention should be paid to ensuring intensive growth.

Taking into account the regional scale of production of agricultural products, it was found that the use of the cluster analysis method is effective for evaluating the efficiency of using the production potential of the region. Based on the results of cluster analysis, developed models representing practical results were proposed in the case of Kashkadarya region.

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