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GRAIN PRODUCTION IN A CLUSTER SYSTEM AND INCREASING THE COMPETITIVENESS OF THE FINAL PRODUCT

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Abstract

This article examines the issues of systematic optimization of production costs in the activities of grain-growing clusters, cost reduction at the stages of the value chain, and increasing the competitiveness of final products (flour and bakery products). The article analyzes the latest institutional reforms in the sector, including the abolition of state procurement quotas and the liberalization of the pricing system. The economic efficiency of mechanisms for state compensation of credit rates, subsidies for diesel fuel , and the re-circulation of vacant land through "E-auction" is assessed. The prospects for introducing water and energy-saving technologies and alternative solar energy into grain-growing landscapes in order to prevent water resource shortages and deterioration of their quality in the context of climate change are highlighted. In order to systematically assess the efficiency of clusters, the methodological foundations of the Data Encompassment Analysis (DEA) model are proposed and relevant conclusions are drawn.

Keywords: Grain clusters, cost optimization, competitiveness, state subsidies, water - saving technologies, alternative energy, Data Coverage Analysis (DCA/DEA).

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Introduction

From the early stages of independence, the Republic of Uzbekistan began implementing a strategy to achieve grain independence in order to ensure food security and economic independence. As part of this strategy, the area of wheat sown in the country was expanded from 0.63 million hectares in 1991 to 1.31 million hectares (35 percent of the current arable land) by 2019. As a result, annual wheat production has steadily increased, reaching 6.09 million tons in 2019, and it has become possible to cover more than 70 percent of the domestic need for food and fodder products through local production.

However, for many years, the practice of mandatory state orders and artificially low price setting, inherited from the former Union planned-administrative system, has limited the economic interests of grain- growing farms. According to analyses , between 2010 and 2018, farmers and farms suffered economic losses of an average of 1.7 trillion soums (at least 15 trillion soums) per year due to the state order system. In 2018 alone, these losses amounted to 3.3 trillion soums (290 USD per hectare or 0.9 percent of GDP). This situation led to low land and labor productivity in the sector and the loss of financial incentives for the introduction of innovative agricultural technologies .

Agriculture and introduce the principles of a market economy into the sector, Presidential Decree No. PQ-4634 of March 6, 2020 was adopted, and starting in 2021, state orders, mandatory purchase prices, and the planned system in grain production were completely abolished. These reforms created the basis for the development of a new integration structure in the sector - grain growing and agro-industrial clusters.

The volatility of food prices on the world market and the complexity of the geopolitical situation require guaranteed provision of the domestic market with high-quality and affordable products. In Uzbekistan, the increase in food prices on the domestic market limits the population's opportunities for healthy nutrition and creates food security risks. According to data , in 2024, 13.2 percent of the

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population (about 4.8 million people) did not have access to a healthy diet, while in 2022–2024, 8.7 million people faced moderate and severe food security problems. During this period, the daily cost of a healthy diet in the country reached 4.67 US dollars.

At the same time, the dependence of the local market on food imports is increasing. For example, in 2025, the volume of food imports will amount to 4.5 billion US dollars, an increase of 23.5% compared to the previous period. In the import structure , meat and meat products accounted for 869 million dollars (+70.6%), dairy and egg products - 322.7 million dollars (+40.0%), and grain imports - 1.058 billion dollars (+15.2%). In this context, developing a strategy to improve the efficiency of local grain- growing clusters, systematically optimize production costs, and ensure the competitiveness of final processed products is of vital importance for the national economy.

Literature review on the topic

The development of economic sectors in a cluster approach is internationally recognized as the most effective factor in increasing the competitiveness of the agro-industrial complex and maximizing regional potential. A regional cluster is a group of enterprises located within the same geographical boundary, interconnected on the basis of a single technological value chain and achieving high synergistic efficiency through rational use of resources. In international experience, clusters form a significant part of the GDP of developed countries; in particular, in the USA, 60% of GDP, and in the European Union, 40% of the employed population, are accounted for by cluster structures.

The processes of optimization and restructuring of farms in Uzbekistan have been discussed for a long time. According to World Bank studies , the optimal size of farm areas for wheat and cotton cultivation is 30-40 hectares, and consolidation beyond this figure will not lead to further increase in economic efficiency. In addition, the low level of provision of dehkan farms with resources (fertilizers,

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fuel, machinery and loans) and high transaction costs hinder their integration into export and market systems.

It is necessary to use scientifically based economic and mathematical models to minimize the costs of the production chain and assess the competitiveness of finished products. In particular, when comparing the efficiency of grain and viticulture clusters for the purpose of optimal allocation of land resources in agriculture, it was found that planting grain on 1 hectare of land can provide employment for 2-3 people and generate a maximum profit of 25 million soums. At the same time, the establishment of a vineyard on this area will create 10 jobs and a profit of more than 250 million soums, as well as an average export opportunity of 25 thousand dollars. This situation indicates that in the activities of grain- growing clusters it is necessary not only to expand extensive areas, but also to intensify the income from each hectare of land.

At the same time, the deterioration of water resources quality under the influence of anthropogenic and natural environmental factors negatively affects the cost of agricultural production and productivity. Researchers note that the deterioration of the quality of water bodies and problems with irrigation systems slow down the development of crops, leading to an increase in the consumption of mineral fertilizers and water. Therefore, it is necessary to introduce advanced agrotechnical innovations to reduce the cost of grain production in the conditions of climate change and water scarcity.

Research methodology

Data Envelopment Analysis (DEA) methodology was used to assess the efficiency of grain production and the level of resource optimization within the cluster system. This methodology is based on a nonparametric mathematical programming system that does not require predetermined weightings and allows for a comparative assessment of several input (resources) and output (outcomes) parameters.

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According to the mathematical foundations of the CCR (Charnes, Cooper, Rhodes) model used in the study, the economic efficiency coefficient (θ, where $0 \le \theta \le 1$) of a particular grain-growing cluster being evaluated is determined by the weighted ratio of produced products and consumed resources. In this case, the gross yield, the amount of processed flour or sales revenue are taken as output parameters , and the input resources are the cultivated area, consumed water resources, diesel fuel , mineral fertilizers and attracted financial credit funds. The weight coefficients of the variables are automatically optimized by the model.

grain- growing clusters operating in different regions were compared with their technological frontier, and the excess consumption of available resources (slack) and cost optimization reserves were quantitatively assessed.

Analysis and results

The analysis shows that reducing costs in grain-growing clusters and increasing the competitiveness of the final finished product depend on the effective use of systematic financial and organizational incentives created by the state. In recent years, Uzbekistan has introduced a new system of state subsidies and compensation to support grain and cotton growers in order to reduce the burden of high costs in the face of climate change.

In particular, farms that have fully repaid preferential loans for grain cultivation within the terms specified in the contract and by August 1 of the harvest year will be compensated by the state for 4 percentage points of loan interest payments. This will lead to a significant (on average , 15-20 percent) reduction in financial costs. In order to reduce the burden of diesel fuel costs, a subsidy of up to 2 million soums is being allocated from the state budget for fuel purchased through the exchange, the cost of which exceeds 13 million soums per ton, which will allow saving total fuel costs by 12-15 percent.

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Also, the powers of the State Agricultural Support Fund to distribute certain subsidies will be transferred to the Agricultural Payments Agency. This agency will cover part of the costs of electronic invoices when selling raw materials grown at the expense of clusters' own funds or commercial loans, which will serve to reduce transaction costs within the cluster. In order to optimize land resources, vacant and pasture lands will be put into use with investment obligations through the "E-auction" platform, and the maximum period for their circulation has been set at 2 years.

One of the most costly sectors in the grain chain is irrigation and energy supply. According to technical analyses conducted on the example of the Republic of Karakalpakstan, Kashkadarya and Khorezm regions of the Republic, the aging of infrastructure and power outages lead to significant losses and increased costs in irrigation systems. The introduction of alternative solar photovoltaic plants and bioenergy devices in grain- growing landscapes ensures the stable operation of water pumps, reduces water consumption by 30 percent and energy costs by 25-30 percent. Practical studies have shown that the use of scientifically based agrotechnologies (for example, drip irrigation) and the correct use of mineral fertilizers, while saving water resources, increases productivity by 20-25 percent by growing disease-resistant and high-yielding wheat.

In order to ensure the stability of grain prices in the domestic market and plan the economic activities of clusters, the Ministry of Agriculture and the Farmers' Council annually announce the minimum expected prices for the next year's harvest by August 1 and make adjustments to it quarterly, based on the market situation. This increases the stability of production and the accuracy of financial planning.

However, the level of vertical and horizontal integration in the Uzbek wheat market is still low. According to research , only 50 percent of regional wheat markets are integrated, and the vertical relationship between wheat and flour prices is observed only in 3 regional markets. This situation requires increasing

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the efficiency of processing capacities of clusters. For example, the experience of Galla-Alteg JSC shows that modern shaft machines and technological control devices maximize the percentage of flour separation from grain endosperm from the traditional 65-68 percent to 75-78 percent. This will help reduce the cost of finished bread and bun products by 10-12 percent by producing high-quality flour, controlling gluten indicators and reducing waste, and supplying premium products that can replace imports in the domestic market.

Conclusion and suggestions

the conducted scientific research and systematic analysis, the following conclusions and proposals are put forward to improve the efficiency of grain-growing clusters in Uzbekistan and ensure the competitiveness of the final finished product:

Centralize and digitize subsidies: The distribution of loan interest rate subsidies and diesel fuel subsidies by the Agricultural Payments Agency through a single "e-invoice" system should be accelerated. This will reduce corruption and bureaucratic hurdles and eliminate the shortage of working capital.

Introducing climate-adapted water and energy-saving systems: To prevent deterioration of soil fertility and water quality, it is necessary to use drip irrigation methods in grain fields and provide water pumps with alternative solar photovoltaic plants in water-stressed regions such as Karakalpakstan, Khorezm, and Kashkadarya.

Vertical integration and liberalization of markets: It is necessary to improve infrastructural and logistical connections between regional wheat and flour markets and ensure the free movement of goods between regions to reduce artificial price distortions.

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Efficiency control based on the MQT/DEA model: It is necessary to systematically evaluate the activities of each grain-growing cluster using the Data Coverage Analysis (DCA) model, identify the factors that cause them to lag behind the technological frontier, and optimize resource overspending (slack).

Technological modernization and deep processing: While maintaining the size of farms within the optimal range of 30-40 hectares, it is necessary to increase the volume of final products with high added value by equipping the milling complexes in the clusters with modern shaft equipment and creating a deep grain processing chain.

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