

Dairy industry as a key element of food security in Kazakhstan

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Abstract. The dairy industry of Kazakhstan plays a key role in ensuring the country's food security, forming a stable domestic market and creating the basis for the sustainable development of the agro-industrial complex. The availability of natural resources, livestock traditions, and government assistance contributes to the development of milk production and processing, but the industry faces a number of systemic problems. Among the main barriers are low herd productivity, seasonality of production, insufficient digitalization, and logistical restrictions. High dependence on imported dairy products creates risks for the independent provision of the population with strategically important products. Development prospects are associated with the introduction of innovative technologies, the expansion of cooperation, the formation of agro-industrial clusters, and the use of economic and mathematical forecasting models. Strengthening export potential, improving product quality, and integration into international standards can become the basis for strengthening Kazakhstan's food independence. The dairy industry can turn into one of the priority drivers of regional development and social stability.

1 Introduction

Food security is one of the key tasks of the social and economic development of the modern state. In the context of global instability, fluctuations in world markets, and changes in climatic conditions, the sustainability of the national food system is of particular importance. Kazakhstan, which has significant agricultural potential, considers dairy production as a strategic direction that directly affects the level of food independence and the quality of nutrition of the population. The dairy industry provides the population with vital products, contributes to the development of rural areas, and the formation of a sustainable economic base for the agro-industrial complex, which makes it one of the key factors in strengthening the country's food security. Dairy production is a complex system that includes various links - from raising cattle to processing raw materials and forming market sales channels[1]. The level of efficiency of each stage determines not only the volume of production and the availability of dairy products, but also the structure of consumption, price dynamics, and dependence on imports. Despite the availability of natural resources and state support, the domestic dairy industry faces a number of problems: low productivity of personal subsidiary

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plots, an insufficient level of cooperation, a shortage of modern processing capacities, and logistics mechanisms. These factors negatively affect the stability of the domestic market and prevent the dairy industry from becoming a driver of food security.

The relevance of the study is due to the need for a comprehensive assessment of the role of dairy production in ensuring the food stability of Kazakhstan, taking into account modern economic realities, market risks, and the potential for the development of the industry [2]. A theoretical understanding of the relationship between milk production, consumption, product availability, and foreign trade flows will identify the key factors determining the stability of the agri-food system. The scientific significance of the work lies in determining the strategic potential of dairy production as a tool to reduce import dependence and increase the self-sufficiency of the population in dairy products. The purpose of the study is to substantiate the role of dairy production in Kazakhstan as a strategic factor in ensuring food security and to identify directions for its development from the standpoint of economic sustainability, efficiency and innovative potential. Achieving this goal requires the use of a modern analytical approach, including economic and statistical methods, assessing regional differences, studying the dynamics of prices and production, as well as modeling possible scenarios for the development of the industry. The results obtained can serve as a basis for the development of government support measures, the formation of cooperative mechanisms and the improvement of agri-food policy [3].

Thus, the study of dairy production in Kazakhstan as a strategic element of food security meets both scientific and practical tasks, opening up opportunities for developing effective management decisions focused on strengthening the national food system and improving the quality of life of the population.

2 Methods

In the study of dairy production in Kazakhstan, a comprehensive methodology based on systemic and statistical approaches was used. The empirical base is based on official data from the National Bureau of Statistics, the Ministry of Agriculture, and international databases covering indicators by region of the country. The analysis includes key variables: the number of cattle, the number of cows, the volume of milk production, average milk yield, gross livestock production, price dynamics, as well as export and import indicators. Data preprocessing includes normalization, statistical robustness testing, and outlier elimination. Additionally, SWOT-analysis is used to assess the strategic potential of the dairy industry from the point of view of sustainable development and ensuring food security. This tool structures the strengths and weaknesses of production, identifies opportunities for modernization, and indicates external threats, including climate risks, price volatility, and import dependence. To interpret the results obtained, progress charts, comparative tables, and charts of distribution of production indicators by regions are used. The combination of statistical methods and strategic analysis ensures the scientific validity of the conclusions and serves as the basis for determining scenarios for the development of the dairy industry in the face of modern economic challenges and the need to increase the level of food independence of Kazakhstan.

3 Results and discussion

The results of the study confirm the strategic importance of dairy production to ensure food security in Kazakhstan. The obtained statistics and analytical findings indicate that the functioning of the dairy industry goes beyond the usual agricultural sector and directly affects the social stability, consumption structure, and nutritional quality of the population. The

sustainable operation of the milk production and processing system is an important condition for reducing dependence on imports and the formation of a domestic market with sufficient saturation with vital products. Analysis of key indicators demonstrates that improving the efficiency of the industry is possible with a combination of government support measures, modernization of production processes and the introduction of innovative technologies. Of particular importance is the ability of the dairy industry to adapt to changing economic conditions, fluctuations in demand and the transformation of consumer preferences [4]. The combination of econometric methods and strategic assessment of the industry made it possible to identify trends characterizing the development of production and the impact of the dairy sector on the food sustainability of the country. An assessment of production potential, the relationship between productivity, price factors and production volumes indicates the need to form an integrated approach to industry management. Strengthening dairy production should be considered not only as an economic task, but also as an important element of national security, requiring long-term strategic planning and the effective use of domestic resources.

Figure 1 shows the total number of cattle from 2017 to 2024.

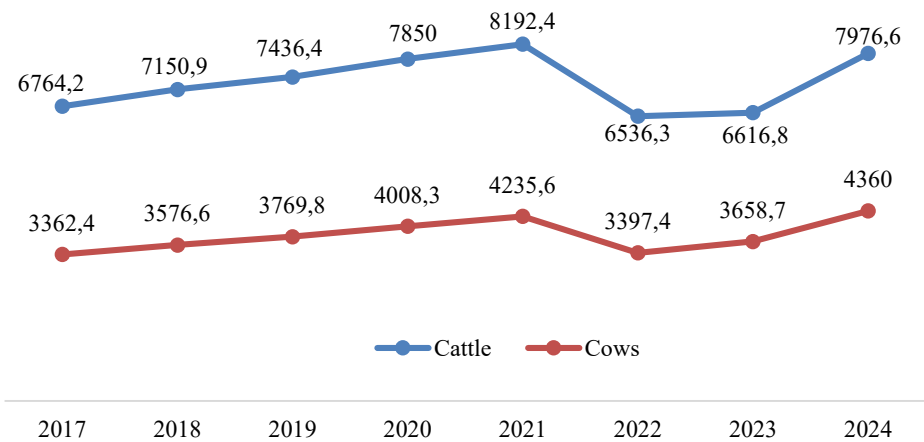


Fig. 1. Total livestock in Kazakhstan, thousand heads.

The statistics presented reflect significant changes in the number of cattle and cows in Kazakhstan from 2017 to 2024. The total number of cattle for the analyzed period shows an upward trend. In 2017, the number was 6764.2 thousand heads, and by 2021, it increased to 8192.4 thousand heads, which indicates a consistent strengthening of the country’s livestock base. This growth can be associated with state support for the industry, the modernization of livestock management technologies, and the active development of peasant farms. However, in 2022, a noticeable decrease was recorded to 6536.3 thousand heads, which reflects the influence of external stressors, probably economic and climatic. But by 2024, the number of cattle recovered to the level of 7976.6 thousand heads, which confirms the ability of the industry to adapt and recover. The dynamics of the number of cows show a similar trend. From 3362.4 thousand heads in 2017, the number steadily increased to 4235.6 thousand heads by 2021 [5]. The decline in 2022 to 3397.4 thousand heads coincides in nature with the reduction in the total number of cattle, which indicates the systemic nature of the change in the industry. In subsequent years, recovery is noted, and by 2024, the number of cows reaches 4360 thousand heads, which is the maximum value for the entire period. This confirms the strengthening of the dairy direction of animal husbandry and the creation of conditions for

stabilizing the raw material base of processing enterprises. Summarizing the results of the analysis, we can conclude that the period 2017-2024, characterized as a volatile, but generally positive stage in the development of livestock in Kazakhstan. The industry demonstrates resilience, the ability to overcome crisis periods, and the formation of prerequisites for further growth. The increase in the number of cattle and cows in 2023-2024 [6] indicates the restoration of production capacity and the strengthening of the role of livestock in ensuring the food security of the country. Trends indicate the need to continue government support, expand breeding, and introduce innovative technologies to improve production efficiency.

Figure 2 shows the volume of milk production in Kazakhstan.

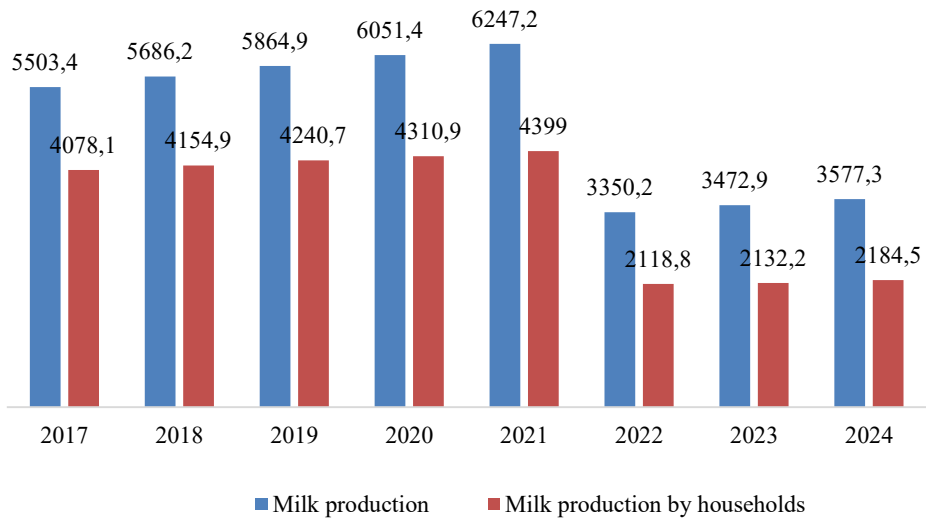


Fig. 2. Total milk production in Kazakhstan, thousand tons.

In the period from 2017 to 2024, Kazakhstan saw significant changes in the volume of total milk production and milk production in households. The total milk production showed a gradual increase until 2021: from 5503.4 thousand tons to 6247.2 thousand tons, which reflects the expansion of the raw material base of animal husbandry and an increase in cow productivity. Such positive dynamics may be associated with the development of breeding work, the introduction of modern feeding technologies and the improvement of veterinary services. However, a sharp decline in 2022 to 3350.2 thousand tons indicates the presence of crisis factors, which could include an increase in cost, a decrease in cattle livestock and a change in business conditions. In subsequent years, there is a partial recovery, and by 2024 production reaches 3577.3 thousand tons, which indicates the beginning of the stabilization of the industry. Household milk production follows a similar trajectory. For the period 2017-2021, there is a moderate but steady growth - from 4078.1 to 4399 thousand tons, which confirms the significant role of personal subsidiary farms in ensuring the country's food security. In the crisis year of 2022, the volume decreased to 2118.8 thousand tons, which also reflects the vulnerability of the small-scale sector to external economic and social influences. In 2023-2024 a gradual recovery is recorded, and the production volume reaches 2184.5 thousand tons, but the indicators remain below pre-crisis values. The analysis indicates that households continue to maintain a key role in the structure of dairy production in Kazakhstan, but in the long term, a transition to more industrialized forms of animal husbandry is needed [7]. The increase in dependence on small manufacturers makes the system less resistant to external fluctuations. Thus, the development of cooperation, the modernization of infrastructure, and the integration of small farms into processing chains can become decisive

conditions for increasing the efficiency of the industry and ensuring food security in the country.

Figure 3 shows the volume of exports and imports of milk and dairy products in Kazakhstan for the period 2017-2024.

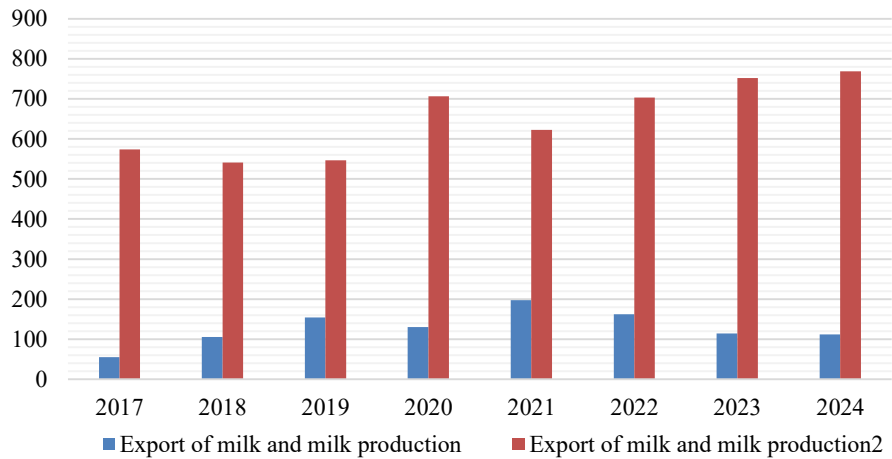


Fig. 3. Export and import of milk and milk production in Kazakhstan, thousand tons.

Data on foreign trade in milk and dairy products show that Kazakhstan remains significantly dependent on imports, while fluctuating export volumes. In 2017-2021, there is a significant increase in exports - from 54.8 to 197.4 thousand tons, which reflects the expansion of production capacities and the intensification of foreign economic activity. The peak of export activity fell on 2021, which may be associated with increasing the competitiveness of domestic products and strengthening trade relations with neighboring countries. However, already from 2022, exports began to decline and decreased to 111.5 thousand tons by 2024, which indicates an increase in internal pressure on the market, a possible increase in domestic demand, and a limited raw material base. Milk imports show a different trajectory - the indicators remain consistently high throughout the period, which indicates a structural shortage of domestic production. In 2017-2019, import volumes were relatively stable, ranging from 541.2-574.0 thousand tons. A sharp increase to 706.4 thousand tons in 2020 may reflect a shortage of domestic supply and the need to cover demand through foreign supplies. In 2023-2024, there is a further increase in imports to 768.8 thousand tons, which confirms the continued dependence of Kazakhstan on the foreign market and the limited self-sufficiency of the country in dairy products [7]. Comparison of export and import data shows a stable negative trade balance throughout the period. Despite the short-term growth in exports, the scale of imports significantly exceeds the volume of supplies abroad. This imbalance indicates a systemic problem - an insufficient production base to cover domestic consumption. The current situation indicates the need for strategic measures: the development of industrial animal husbandry, support for cooperation, improving the processing infrastructure, and stimulating the export of products with high added value. Only with an integrated approach is it possible to reduce import dependence and form a competitive dairy sector capable of ensuring food security in Kazakhstan.

Table 1 shows the SWOT analysis of the development of the dairy industry in Kazakhstan, which identifies the strengths and weaknesses of the development of the dairy industry in the republic.

Table 1. SWOT analysis of the development of milk and milk production in Kazakhstan.

- Availability of pastoral land and animal husbandry traditions. - Formation of recycling infrastructure and cooperatives. - Government support programs (subsidies, concessional lending). - Stable domestic demand for dairy products. - Availability of large processing plants.	- Low herd productivity and lack of genetic renewal. - A high proportion of small farms without access to cooling and processing technologies. - Weak digitalization and fragmented supply chains. - Seasonality of production and supply instability. - Lack of qualified specialists and low level of certification
- Export prospects to CA countries, China and the Middle East. - Digitalization of production and cluster development. - Development of markets for organic and functional products. - Expansion of cooperation and farm associations.	- High dependence on imports of products and equipment. - Exchange rate fluctuations and cost increases. - Climatic risks and decrease in the quality of the food supply. - Increase product quality and safety requirements. - The risk of slowing down modernization with insufficient state support.

The SWOT analysis shows that the development of the dairy industry in Kazakhstan is determined by a combination of resource advantages, institutional support and growing consumer demand, which forms a strategic basis for industry growth. Strengths include the presence of extensive pastoral land, established animal husbandry traditions, the functioning of processing plants, as well as government support programs aimed at updating the herd and modernizing production facilities. The presence of domestic demand for dairy products creates a stable sales market that allows you to plan production volumes and directions. At the same time, a number of significant restrictions were identified that hinder the increase in industry efficiency [8]. Among the key weaknesses are the low productivity of animals, the insufficient level of genetic renewal, the fragmentation of the logistics infrastructure and the lag in the digitalization of accounting and product quality control. A significant proportion of products are produced by small farms, which often do not have access to modern equipment and certified distribution channels. The seasonal nature of production leads to unstable supplies, and the lack of qualified personnel complicates the introduction of innovative technologies and food safety standards. Despite internal limitations, the industry has significant development potential. Opportunities are associated with the expansion of export destinations to the countries of Central Asia, China and the Middle East, as well as with the growth in demand for organic, functional and specialized food products. Digitalization of the dairy sector and the formation of logistics hubs can significantly reduce costs and increase the manageability of industry processes [9].

External threats are associated with a high dependence on imports of equipment, feed additives, and partially finished products, which creates risks in the face of currency fluctuations and changes in foreign trade conditions. Climatic changes can affect the quality of the food supply and increase veterinary risks. Strengthening requirements for quality and safety standards in retail chains and foreign markets requires additional investment, which can become an obstacle for small farms. With insufficient government support, there is a threat of technological lag and increased competition from foreign manufacturers [10].

Thus, the dairy industry in Kazakhstan has high strategic significance and potential for growth, but requires a comprehensive transformation based on infrastructure modernization, farm cooperation, digitalization of processes, and evidence-based risk management. The introduction of innovative technologies and economic and mathematical modeling can ensure

the sustainability of the industry and bring it closer to international standards for efficiency and food security.

4 Conclusion

Dairy production in Kazakhstan is a key element of the country's food security, providing the population with vital food and forming a sustainable basis for the development of the agro-industrial complex. Industry analysis has shown that Kazakhstan has significant resource potential, including vast pasture lands, a high demand for dairy products in the domestic market, and the availability of processing infrastructure. State support aimed at developing animal husbandry, subsidizing the modernization of enterprises, and stimulating cooperation creates the prerequisites for the formation of a competitive dairy industry.

At the same time, barriers have been identified that require a systematic solution. Low herd productivity, limited access of smallholders to modern technologies, seasonal fluctuations in production, and high logistics costs prevent stable demand satisfaction. In addition, dependence on imports of dairy products remains, which creates risks in conditions of geopolitical instability and changes in foreign trade conditions. These factors indicate the need to introduce modern management mechanisms, digital quality control systems, and economic and mathematical forecasting models to improve the efficiency of the industry. Comprehensive modernization of the dairy sector can become a strategic tool for strengthening food security in Kazakhstan. Thus, the dairy industry of Kazakhstan can become not only a source of stable food supply, but also a driver of socio-economic development of the regions. The combination of government support, a scientific and analytical approach, and integration into global value chains will make dairy production one of the priority areas for ensuring food independence and improving the quality of life of the population.

This research is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan for 2021-2023, Grant No. AP09261075 - The formation of a model of a regional food hub as a horizontally integrated structure to ensure food security (using the example of the meat cluster of the Turkestan region).

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