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Mechanisms for improving the economic efficiency of livestock development in the Republic of Kazakhstan

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ABSTRACT

The purpose of this study is to determine the optimal ways to increase the economic efficiency of animal husbandry, considering the problems of development and efficiency of the livestock industry in Kazakhstan. The results are based on the systematisation of the information studied, which highlights the trends in the development of the livestock industry of the Republic of Kazakhstan from 2018 to 2022, considering the foreign experience in the development of the industry, which determined the optimal mechanisms for improving the economic efficiency of the livestock industry in Kazakhstan. The balance of Kazakhstan's foreign trade was calculated.

Keywords*: Agricultural activity; management mechanisms; output volumes; dairy cattle breeding; poultry farming.*

1 Introduction

When it comes to the economic development of any country, it is impossible to ignore the development of its individual industries. The agro-industrial complex (AIC) has a significant impact on the economic well-being of the Republic of Kazakhstan. AIC includes all branches of the economy and farms involved in the production of agricultural products. In turn, the branch of agriculture includes crop production and animal husbandry. Animal husbandry, as a crucial component of the agro-industrial complex in the Republic of Kazakhstan, plays a pivotal role in ensuring the nation's food security, generating employment opportunities, and bolstering economic growth (Sivolap et al., 2022). This sector encompasses the breeding, rearing, and management of various livestock species, including cattle, sheep, goats, horses, and poultry, among others. The development of animal husbandry in Kazakhstan is intricately linked to the country's climatic and geographical conditions. With its advantageous natural and climatic characteristics, such as its vast expanses of pastureland, diverse ecosystems, and abundant water resources, Kazakhstan provides an ideal environment for the efficient operation of livestock farming activities (Kolluru et al., 2023). These favourable conditions facilitate the cultivation of high-quality feed crops and grazing lands, essential for sustaining healthy and productive livestock populations (Yerzhanova et al., 2021).

Moreover, Kazakhstan's strategic geographical location further enhances its potential for animal husbandry development. Situated at the crossroads of Europe and Asia, the country benefits from access to various markets, both domestic and international, fostering opportunities for trade and export of livestock products (Liang et al., 2020). In addition to geographical advantages, Kazakhstan possesses a rich raw material base, including ample reserves of feed grains, forage crops, and mineral resources essential for animal nutrition and health (Kerimkhulle et al., 2021). This abundance of resources forms the foundation for the sustainable growth of the livestock sector, enabling producers to meet domestic demand for meat, dairy, and other animal-derived products while also exploring opportunities for export to global markets (Akhmetsadykova et al., 2022).

Consumption of AIC products, in particular, livestock products per capita, is one of the most significant economic indicators reflecting the level of development of a country. When domestic demand for these products increases, it creates opportunities for farmers and producers to expand their operations to meet this demand (McDonald et al., 2019). This can lead to investments in improving infrastructure, technology, and practices within the agricultural sector. Moreover, when the domestic market for livestock products grows, it can also stimulate exports, further boosting the sector's growth and economic contribution. Kazakhstan, like many other countries, relies on the agricultural sector for economic development and food security (Jia et al., 2022). Therefore, increasing domestic demand for livestock products can be a key driver for enhancing the quality and quantity of production in the country (Kirkimbayeva et al., 2015). Over the past years, the gross output of the livestock sector has grown from 204.95 billion KZT (2018) to 216 billion KZT (2022), which indicates an increase in demand for livestock products (Bureau of National Statistics, 2024). Increasing the turnover of livestock production leads to a certain number of difficulties, which are increasingly faced by livestock workers. Liu et al. (2020) note that along with the already familiar challenges (optimisation of logistics, finding new sales markets, increasing the quantity and improving the quality of products), modern farmers face problems associated with the introduction of innovative technologies in the production process and difficulties in using new analytical and predictive technologies.

However, the inability of livestock workers to qualitatively introduce innovations into the production process and the low level of qualification of personnel in the industry have a much greater negative impact and contribute to the emergence of a number of problems. This issue arises from various factors, including inadequate training programmes, limited access to updated technological resources, and perhaps a reluctance to embrace change due to traditional farming practices. The lack of skilled personnel hampers the adoption of modern farming techniques and technologies, leading to inefficiencies, decreased productivity, and higher operational costs (Akudugu et al., 2023). To address these challenges, concerted efforts must be made to invest in comprehensive training programmes tailored to the specific needs of the livestock industry. These programmes should focus on equipping workers with the necessary skills and knowledge to effectively implement innovative technologies, such as automated feeding systems, data analytics for herd management, and precision farming techniques. Additionally, initiatives to improve access to advanced agricultural machinery and equipment, as well as ongoing support and guidance from agricultural experts, can facilitate the successful integration of these technologies into daily farm operations (Ruzzante et al., 2021). Fostering a culture of innovation and openness to change within the livestock industry is crucial. Farmers need to recognize the benefits of embracing technological advancements, such as increased efficiency, higher yields, and improved animal welfare, to remain competitive in today's agricultural market (Yatsiv et al., 2022).

One of such significant problems is the issue of the impact of the livestock industry on the environment. Omarov et al. (2021) describe the problem of greenhouse gas emissions in the process of agricultural waste disposal. The authors propose the introduction of innovative technologies to reduce the level of negative impact on the environment, which requires significant financial investments. The problem of the negative impact of the agro-industrial complex on the

environment is also described by foreign researchers. Xue et al. (2019) call animal husbandry the main cause of global greenhouse gas emissions into the atmosphere. It is worth noting that the current problem has a global scale. The Paris Agreement (United Nations, 2015) was signed, coordinating the international community in the process of transitioning to a low-carbon economy.

However, the process of transitioning to newer systems of animal waste disposal, reducing carbon dioxide emissions, and adapting the existing production structure to new requirements is extremely costly and requires significant financial resources. Thus, the field of animal husbandry requires finding optimal mechanisms to increase economic efficiency, which, subsequently, will provide the necessary financial level for the introduction of the required technologies to ensure the environmental friendliness of agricultural production, which determines the purpose of this study.

2 Materials and Methods

2.1 Research methodology

The study primarily relied on papers by Kazakh and foreign authors, focusing on effective mechanisms for agricultural and livestock industry development. It also analysed the global environmental impact of the livestock industry to identify optimal pathways for future development. Moreover, the theoretical basis of this study was based on official statistical data of the Republic of Kazakhstan, presented by the Bureau of National Statistics (2024), and the legislative framework presented by the Governmental Decree of the Republic of Kazakhstan No. 732 “On Validating the National Project for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021-2025” (2021). All the materials used are in the public domain.

2.2 Benchmarking analysis and trade balance calculation

The methodological basis of this study allows for considering the degree of influence of animal husbandry on the economy of the Republic of Kazakhstan and the level of influence of the agricultural sector on the global environmental situation. As part of the current study, an analysis of the livestock industry in Kazakhstan in the period from 2018 to 2022 (inclusive) was carried out. The covered time period allowed for an in-depth analysis of trends and the economic state of the livestock industry in Kazakhstan. The methodological basis of the study is based on such an empirical research method as benchmarking, which allows for a more qualitative and in-depth analysis of the livestock industry of the Republic of Kazakhstan. Benchmarking is an analysis tool that determines potential ways of developing (adapting) the livestock industry based on a comparison of the current level of the industry with a reference indicator. The comparative base is the experience of countries such as Mongolia and Argentina.

The process of conducting the analysis through benchmarking covered the study of demographic, political, economic, social, and climatic factors of influence in Kazakhstan and around the world. Benchmarking includes two stages:

1. Determination of the level of development of the industry (assessment).
2. Comparison of current indicators with reference indicators (comparison).

As part of the benchmarking, it became possible to determine the situation in the industry, ways to adapt the industry, and introduce possible changes in the production and management processes of the industry to ensure an increase in the economic indicators of the livestock industry in the Republic of Kazakhstan.

The authors also used the calculation of the foreign trade balance of the Republic of Kazakhstan in the livestock sector. The calculation was carried out according to the following equation:

$$\text{The balance of external trade} = \mathrm{E}_{\text{curr.year}} - \mathrm{I}_{\text{curr.year}}, \quad (1)$$

where $\mathrm{E}_{\text{curr.year}}$ – the value of exports of products for the current year; $\mathrm{I}_{\text{curr.year}}$ – the value of imports of products for the current year.

At the moment, the livestock industry of the Republic of Kazakhstan is quite heterogeneous. With this in mind, for a more complete and accurate analysis, the main areas of animal husbandry in the regions of the Republic of Kazakhstan are considered and the main specifications are identified, which include: dairy cattle breeding, poultry breeding, herd horse breeding, and sheep breeding.

3 Results

3.1 Overview of the livestock industry in Kazakhstan

The Republic of Kazakhstan is an agrarian country, ensuring the satisfaction of the domestic needs of the country through the consumption of high-quality agricultural products. Agricultural products are divided into groups, which

include: crop production, fish and forestry, and animal husbandry. Animal husbandry, in turn, is one of the most significant sectors of the economy of the Republic of Kazakhstan (Kazakhstan Stock Exchange, 2021). In recent years, the Government of Kazakhstan has been paying increasing attention to the development of AIC, creating and implementing development programmes, which include the Governmental Decree of the Republic of Kazakhstan No. 732 "On Validating the National Project for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021-2025" (2021). Within the framework of the designated Project, it is planned to increase the productivity of AIC enterprises, increase exports, and provide the population with socially significant goods.

It is worth noting that from 2018 to 2022, there has indeed been growth in the agricultural and livestock sectors in particular. Thus, Figure 1 shows the trend of growth in the gross output of the livestock industry in the period from 2018 to 2022.

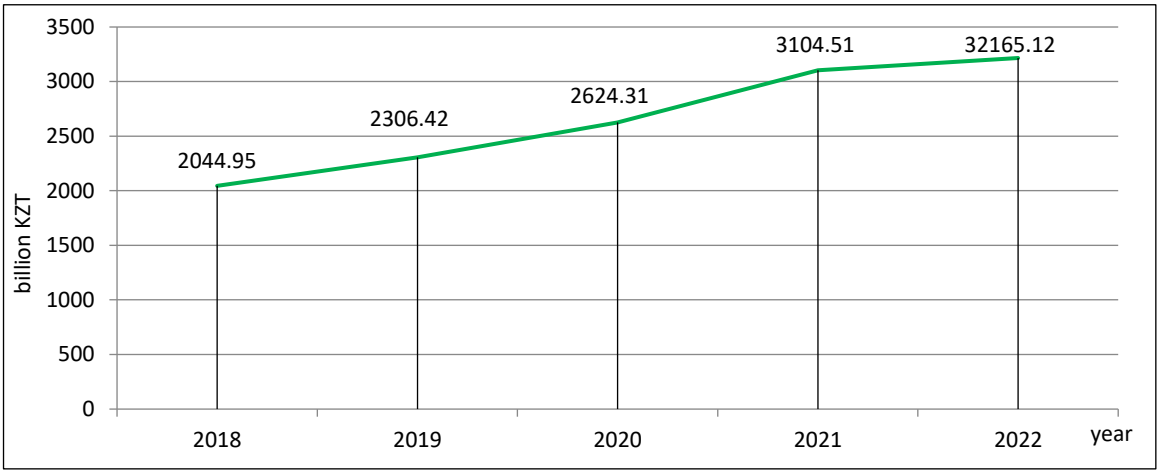

Figure 1. Gross output of livestock industry of the Republic of Kazakhstan (2018-2022).

The results obtained demonstrate a tendency to increase the gross output of livestock production in Kazakhstan over the 5 years (2018–2022). The increase amounted to more than 57%, which corresponds to 1,171.17 billion KZT in monetary terms (Scaling Up Livestock…, 2022). However, the division of the sector is uneven in terms of geographical location. Thus, the largest indicator of livestock production in the Republic of Kazakhstan as of the end of 2022 is represented in the Turkestan region (356.5 billion KZT); the smallest is Astana (0.36 billion KZT). The division of the sector by output volume is shown in Figure 2.

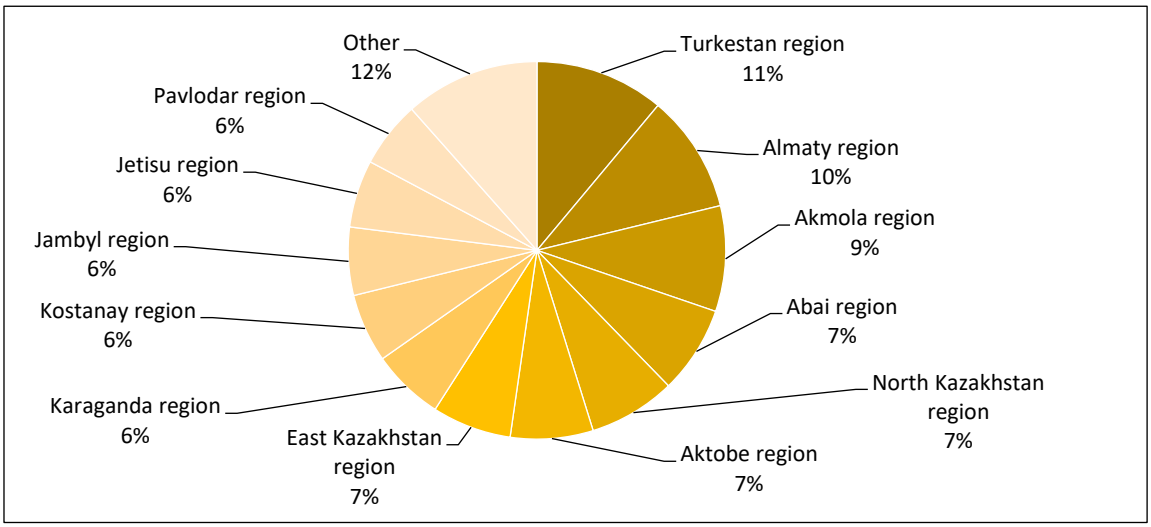

Figure 2. Share of the regions of the Republic of Kazakhstan in the gross output of the livestock industry, billion KZT (2022).

According to these data, it can be seen that the Turkestan region alone produces almost the same number of products (11%) as 8 other regions combined (West Kazakhstan region, Atyrau region, Kyzylorda region, Ulytau region, Shymkent, Mangistau region, Almaty and Astana). This indicates the uneven development of animal husbandry on the territory of the Republic of Kazakhstan. Considering the industry leaders among the regions, it is worth noting the changes in the volume of livestock products from 2018 to 2022. The results are shown in Figure 3.

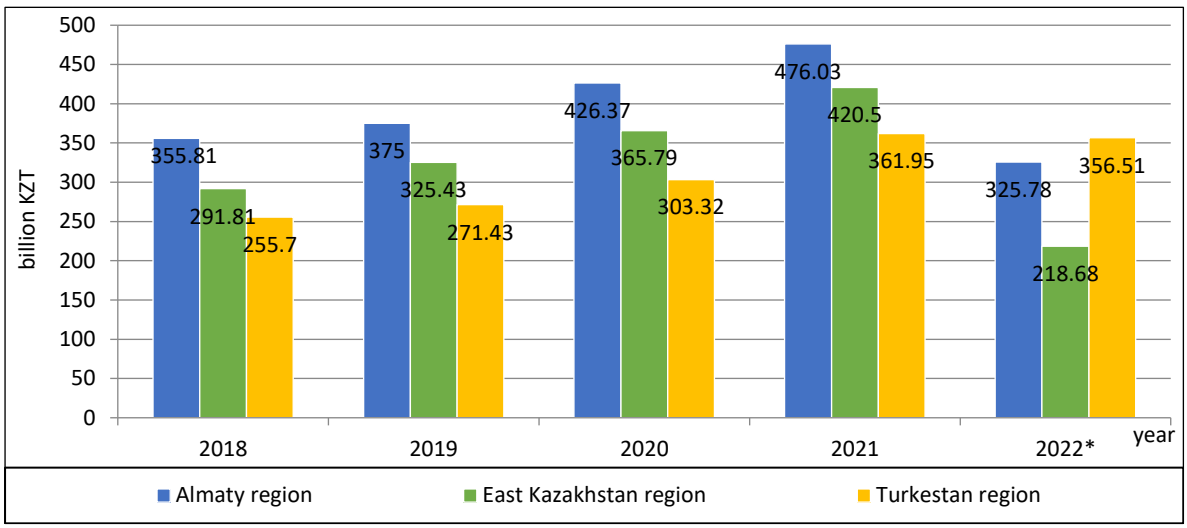

Figure 3. Leading regions in terms of livestock industry output (2018-2022)
(*Note: In 2022, the East Kazakhstan region lost its place in the top three in terms of output of the Akmola region, dropping to 4th place)

3.2 Leading regions and their specialisations

It follows from the graph data that the leaders of the livestock industry in terms of production volumes from 2018 to 2022 were 3 regions – Almaty, East Kazakhstan, and Turkestan. These regions are located in the southeast of the Republic of Kazakhstan, and their high level of productivity in the livestock industry is provided by the natural potential of the regions, the natural and climatic conditions, and the geographical location of the districts. For the East Kazakhstan region, the leading industry is animal husbandry; the main orientation of the industry is cattle breeding, sheep breeding, and horse breeding, concentrated in the mountainous part of the district. The Almaty region fully satisfies the demand of Kazakhstanis for poultry meat, while the Turkestan region specialises in the production of raw leather and lamb fur (Yerassyl et al., 2022). Speaking about the efficiency of the livestock industry in the Republic of Kazakhstan, it is impossible not to consider the socio-economic, climatic, and geographical indicators of the country. The main technical and economic indicators of Kazakhstan are shown in Table 1.

Table 1.
Socio-economic indicators of the Republic of Kazakhstan (2018-2022)

Indicator	**2018**	**2019**	**2020**	**2021**	**2022**
Population of the country (million people)	18.4	18.6	18.9	19.1	19.7
GDP per capita (million KZT)	3.38	3.76	3.77	4.42	5.17
Gross livestock production (trillion KZT)	2.1	2.3	2.6	3.1	3.6
Number of livestock and poultry at the end of the year (million units)					
Bovine cattle	7.15	7.44	7.85	8.19	8.53
Sheep and goats	18.7	19.15	20.06	20.88	19.6
Pigs	0.8	0.81	0.82	0.78	0.8
Horses	2.65	2.85	3.14	3.49	3.65
Bird	44.3	45.0	43.3	47.9	50.2

Thus, as can be seen from Table 1, the data show the development of Kazakhstan's economy and livestock farming in particular. From 2018 to 2022, the number of livestock and poultry in the Republic of Kazakhstan has increased in almost all categories. In turn, the increase in the number of heads of cattle for 5 years will be about 19%; the number of sheep and goats has increased by almost 5%; the number of horses has increased by more than 37.5%; and the number of poultry has increased by 13%. The only indicator that does not show growth is the number of pigs; the number has been

around 0.8 million units at the end of the year for the period from 2018 to 2022. The trends of recent years show growth and positive dynamics. The total number of products produced as well as the growth of the gross domestic product (GDP) indicator of the livestock industry also demonstrate positive dynamics, ensuring the feasibility of the development of the livestock industry in the Republic of Kazakhstan.

3.3 Comparative analysis of the livestock industries in Kazakhstan, Argentina, and Mongolia

As part of the analysis, through benchmarking, a comparative analysis of the livestock industry of the Republic of Kazakhstan was carried out with similar indicators of the livestock industry of two other countries: Mongolia and Argentina. The results of the comparative analysis are presented in Table 2.

Table 2.

Comparative analysis of the livestock industry (2022)

Indicator	Kazakhstan	Argentina	Mongolia
Area of the country (thousand km^2)	2,724.9	2,780.4	1,564.12
Total area of territories allocated for animal husbandry (thousand km^2)	177	300	638
Number of livestock and poultry at the end of the year (million units):			
Bovine cattle	8.53	14.5	5.1
Sheep and goats	19.6	40.1	8.2
Pigs	0.8	8.2	4.3
Horses	3.65	2.5	1.3
Birds	50.2	82.1	1.29
Output volumes:			
Milk (billion litres)	6.32	11.56	1.1
Eggs (billion units)	5.03	1.8	0.01
Cattle meat (million tonnes)	2.17	8.8	1.3
GDP per capita (USD)	11.3	12.4	4.1
Number of industry employees (million people)	0.6	5.2	0.02
Population of the country (million people)	19.7	45.5	3.3
Availability of state support for the livestock industry, through the provision of grants, benefits, subsidies and the introduction of state development programmes (yes/no)	yes	yes	yes

Source: Bureau of National Statistics (2024), United States Department of Agriculture (2022).

Thus, the data given in Table 2 demonstrate that animal husbandry in Argentina, with a similar area of territories, occupies a larger percentage of the area and is much better developed than animal husbandry in the Republic of Kazakhstan. First of all, this is conditioned by the large number of people involved in the livestock industry. On average, one in 9 Argentinians is an employee of the livestock industry, whereas in the Republic of Kazakhstan, the figure is much lower; about one in 32 Kazakhs work in the livestock industry. This may be conditioned by the fact that, despite the versatile development of Kazakhstan, the livestock industry, although significant and important, is not the only effective industry (Kazakhstan Stock Exchange, 2021). Speaking about Argentina, it is worth noting that such a high level of involvement of the Argentine population in the livestock industry is conditioned by the fact that Argentina, unlike Kazakhstan, focuses on the development of the livestock industry as the main branch of the economy (De la Lama et al., 2022). Moreover, Argentina has for many years been one of the largest producers of agricultural goods in the world, with large-scale agricultural and livestock industries.

Mongolia, in turn, has faced enormous difficulties in recent years. More than 75% of Mongolia's territories are subject to drought, which reduces the level of efficiency of the entire agro-industrial complex and animal husbandry in particular (Fernández et al., 2022). Moreover, according to the data obtained, Mongolia demonstrates the lowest economic indicators of all the analysed countries. The low level of involvement of the working population in the livestock industry (every 165 inhabitants of the country is an employee of the livestock industry) also affects the level of development of the industry. The determination of the efficiency of the livestock industry is also influenced by the study of climatic and geographical indicators presented in Table 3.

In general, the nature of Kazakhstan is known for its diversity, including mountainous and desert landscapes. The climate of the Republic of Kazakhstan is sharply continental, which is expressed in sufficiently strong differences in summer (warm) and winter (low) temperatures and determines the need for animal husbandry in accordance with temperature changes. For example, dry periods lead to a decrease in AIC productivity and a reduction in animal feed production, which increases the cost of purchasing feed in third-party countries and, as a result, reduces the economic efficiency of the sector (Tugjamba et al., 2021). In addition, there is a reverse influence. Thus, the livestock industry influences climate change (Peterson et al., 2020). Within the framework of the global programme to reduce the negative impact

of AIC (in particular the livestock sector) on the environment and climate change (United Nations, 2015), the direction of industry development was determined. It is recommended to introduce innovative technologies to reduce the negative impact of AIC on the environment for all countries actively engaged in agriculture.

Table 3.
Climatic and geographical indicators of Kazakhstan (2022)

Indicator	2022
Area of the country (thousand km^2)	2,724.9
Average annual precipitation (mm/m^2)	200-650
Average humidity (%)	64
The driest period (%)	June-August (47)
Period with the highest humidity (%)	December-January (80)
Average temperature in warm months (°C)	+22…+32
Average temperature in cold months (°C)	-9…-20
The warmest month (average value, °C)	July (+22.4)
Coldest month (average, °C)	January (-9.9)

It is worth noting that the introduction of such technologies and the reform of the AIC system are extremely costly processes. To achieve visible results, significant financial investments may be needed. Investments in the livestock industry of Kazakhstan are not the only option for obtaining the necessary amount of money, additional mechanisms can also be measures aimed at improving the economic efficiency of livestock enterprises and increasing production volumes. The need to increase production volumes by increasing the number of livestock is also indicated by data on the import and export of livestock products in the Republic of Kazakhstan. Data on the volumes of imports and exports of meat in the Republic of Kazakhstan are given in Table 4.

Table 4.
Export and import of meat and meat products (2018-2022)

Indicator	2018		2019		2020		2021		2022	
	thousand tonnes	million USD	thousand tonnes	million USD	thousand tonnes	million USD	thousand tonnes	million USD	thousand tonnes	million USD
Export	17.2	57.2	27.8	43.7	33.1	61.7	39.8	82.5	45.4	156.2
Import	211.4	207.1	300	269.4	381.2	369.6	400.8	631.3	238	448.5

According to the data given in Table 4, the export of livestock products in Kazakhstan from 2018 to 2022 is significantly less than the import indicator, which indicates that the quantity of products produced is insufficient. To determine the current level of efficiency of the industry, the balance of foreign trade of the Republic of Kazakhstan in 2022 is calculated according to equation (1), which is 292.27 million USD (156.18 million USD minus 448.45 million USD). According to the obtained result, the balance of foreign trade of the Republic of Kazakhstan in the livestock industry has a negative value, which indicates the emergence of a passive trade balance and low efficiency in the industry. The current state of the livestock industry in Kazakhstan is not optimal and requires an increase in production volumes to increase the efficiency of the industry. It is worth noting that the Republic of Kazakhstan has the potential to increase the efficiency of the livestock industry. In order to achieve high results, based on the current course of development of the country (United Nations, 2015), it is possible to propose some mechanisms to increase the level of economic efficiency in the development of the livestock industry.

Thus, the process of increasing the volume and improving the quality of manufactured products can be facilitated by a system of better-quality control of animal health. The quality of the products produced also directly depends on the quality of the feed. Thus, it is recommended to plant more meadows (Michalk et al., 2019), which are the predominant source of feed for livestock. Reducing the level of feed imports and increasing domestic production of ready-made feed also serve as effective tools to increase economic efficiency. Increasing the number of livestock organisations with multi-species livestock breeding will achieve a competitive position in some indicators. For example, the indicators of the number of pigs in Kazakhstan are significantly lower than the same indicator in Argentina, which indicates that Kazakhstan's export volumes are insufficiently competitive (Shahini et al., 2023).

3.4 Factors affecting the development of the livestock industry

In Kazakhstan, an array of initiatives and government programmes are strategically implemented to advance the livestock industry's competitiveness, inclusivity, and environmental sustainability. The Sustainable Livestock Development Program for Results in Kazakhstan (World Bank, 2021) focuses on addressing important public policy issues to enhance the competitiveness, inclusiveness, and environmental sustainability of the livestock sector. It aims

to improve veterinary and animal health service provision for small and medium farmers, promote small and medium entrepreneurship, and support the development of environmentally sustainable, inclusive, and competitive beef production. The objectives of the Sustainable Livestock Development Program for Results (Words Bank, 2021) include supporting the development of environmentally sustainable, inclusive, and competitive beef production in Kazakhstan. The programme is designed to improve public expenditure in support of beef cattle production and processing that addresses green growth and sustainability in the beef sector. To ensure that the Program does not carry corruption risks, specific measures have been introduced during Program preparation and implementation, such as detailed assessments of financial management systems and the establishment of independent verification of the Program's results.

The Sustainable Livestock Development Program for Results (Words Bank, 2021) includes activities such as operationalizing Green Growth principles in government programmes. The objective of these initiatives is to mainstream Green Growth in the livestock sector, promoting export-oriented meat production and rural growth while addressing environmental concerns associated with livestock production. The World Bank provided a loan to Kazakhstan for livestock sector development in response to high-level priorities outlined by President Tokaev, aiming to diversify the country's exports away from minerals and oil, boost small and medium business growth, create opportunities for socioeconomic development in rural areas, and increase agricultural productivity while fostering environmentally friendly production. The World Bank approved a loan for Kazakhstan in 2020, and the implementation of the Program started in 2021 after going through several stages of approval at the national level and ratification by the country's Parliament.

The livestock industry in Kazakhstan is facing a range of challenges that span environmental, infrastructural, and regulatory domains. Animal husbandry practices are complicated by climatic variability, which ranges from harsh winters to arid summers. Inadequate infrastructure impedes efficient transportation and market access, particularly in remote areas (Robinson et al., 2021). Livestock are vulnerable to outbreaks due to inadequate disease control and veterinary services. Furthermore, land degradation and overgrazing degrade pasture quality, worsening water scarcity issues in semi-arid regions. Market volatility, limited technology adoption, and policy inconsistencies further constrain the sector's growth potential (Hu et al., 2020). To address these challenges, a comprehensive approach is necessary, which involves investing in infrastructure, research, and veterinary services. Additionally, sustainable land management practices and policy reforms are required to promote resilience and competitiveness in Kazakhstan's livestock industry.

The introduction of the "green energy" system and the development of the bioenergy industry also has a high potential for economic efficiency due to the further reduction of costs for the energy resources used (Aizhana et al., 2022). In turn, the training and professional development of employees can have a positive impact on the development of the industry, providing the entire agro-industrial complex of Kazakhstan with high-class specialists capable of working efficiently with the technologies being implemented (for example, digital accounting databases and forecasting programmes). The widespread introduction of digital technologies will contribute to the diverse development of the livestock industry, including the optimisation of production processes, analysis, and simplification of logistics processes in the industry, as well as the optimisation of supplies and normalisation of the number of necessary stocks (for example, feed) (Jiang et al., 2022; Alonso et al., 2020).

The introduction of educational programmes within the framework of state support, providing preferential conditions for education, can stimulate the population to work in the AIC industry, including the livestock industry. Moreover, an increase in the number of employees in the livestock industry may lead to a reduction in the overall indicator of the unemployed population of the Republic of Kazakhstan. An additional method that provides an increase in economic efficiency from the point of view of state support is to stimulate the export of livestock products. Such mechanisms include subsidies, reduced customs duties, consulting support for exporters, and compensation for exhibition costs for farmers. The results of the study demonstrate that the development of the livestock industry in the Republic of Kazakhstan is quite promising. At the moment, based on the proposed options for the development of the industry, the optimal solution for many livestock farms may be staff training (Chaban, 2022).

Within the framework of this area, it is advisable for livestock industry enterprises to conclude cooperation agreements with higher and secondary specialised educational institutions, involving the organisation of pre-graduate practice at livestock industry enterprises and further employment of students of educational institutions (Dolhikh, 2023). Such a tool is not extremely costly and is beneficial for all parties to cooperation. However, the possibility of concluding such agreements should extend not only to private but also to public educational institutions. For this, it is necessary to ensure state support for initiatives in the livestock sector. Moreover, livestock enterprises or agricultural holdings can offer programmes that provide for reimbursement of full or partial tuition fees for students or provide them with scholarship support, followed by mandatory employment of such students at these enterprises for a certain period. This will allow students who do not have the opportunity to study on a commercial basis to get a higher education and a workplace, and enterprises to provide themselves with qualified personnel without the risk of high staff turnover (Tyukhtenko and Makarenko, 2016).

Raising the qualification level of new personnel, provided by obtaining practical work experience in the framework of education and measures aimed at improving the qualifications of existing employees, will enable the growth of economic indicators in the livestock industry. Moreover, an increase in the general level of education of personnel will facilitate the rapid and effective introduction of digital and innovative technologies into production, for example, reducing the cost of retraining personnel (Karabayev et al., 2023). The state should also be interested in such areas as increasing the efficiency of the livestock industry in Kazakhstan, as the involvement of qualified specialists will help reduce turnover and the inefficiency of personnel and increase the sustainability of the industry. The possibility of attracting young specialists to work in the livestock sector in the context of cooperation agreements, with the provision of practice bases and further employment of graduates, will reduce the unemployment rate among the young population and will improve the economic indicators of the country.

At the same time, livestock industry enterprises should not neglect other mechanisms for improving efficiency. In a general sense, economic efficiency is the ratio of economic costs to the resulting result. In order to increase the level of economic efficiency of the livestock industry, attention should be focused on optimising production processes in the industry; supporting the direction of “green energy” (which allows reducing fuel, electricity, and heating costs, as well as reducing the negative impact of the industry on the environment), the introduction of educational programmes; the use of digital technologies; optimising the process of collecting the necessary information, in order to increase control, update information and achieve transparency of production processes; increasing the level of state support for the industry, especially towards adapting the industry to environmental initiatives.

4 Discussion

4.1 Current state and potential of the livestock industry in Kazakhstan

Both Kazakh and foreign researchers have investigated the development of the livestock industry, covering historical aspects of its development, current trends, ways to improve the efficiency of the livestock industry, and issues related to the degree of impact of the livestock industry on the environment. Ensuring a high level of economic efficiency achieved through the discovery and implementation of traditional mechanisms will subsequently allow the introduction of the latest digital control and management systems, processing systems, and waste disposal systems that have arisen in the course of the activities of livestock enterprises and reduce the overall negative impact of the livestock sector of the Republic of Kazakhstan on the ecological situation.

Martin et al. (2020) discussed the economic viability of increasing the number of farms oriented towards multi-species livestock production. This area, indeed, can become effective due to the potential increase in the number of livestock products produced by the Republic of Kazakhstan for export. Thus, relying on foreign experience, by increasing the number of pigs in the Republic of Kazakhstan, it is possible to achieve a significant increase in the export indicator, which will lead to an increase in the profitability of the livestock industry (Sinoimeri and Teta, 2023). At the moment, the exports of the livestock industry of the Republic of Kazakhstan are significantly lower than the imports, which indicates a rather low efficiency of the industry.

4.2 Innovative approaches and digital transformation in Kazakhstan's livestock sector

Benjamin and Yik (2019) consider the prospects of introducing innovative technologies into the livestock industry, offering to use systems based on the technology of remote monitoring of livestock in real time. Such technologies help to monitor the welfare of livestock qualitatively and to control the level of productivity. At their core, these technologies allow for improving the quality of livestock care and reducing the burden on the company’s personnel. Unfortunately, the use of such technologies in the agro-industrial complex of the Republic of Kazakhstan is practically not developed at the moment. Only a small number of agricultural enterprises have already implemented innovative quality control and livestock condition control systems in the production process (Kerimkhulle et al., 2023). Innovation is still at a low level. The entire agro-industrial complex, and the livestock sector in particular, have yet to reform and adapt existing production, management, and logistics systems to meet new requirements (Taishykov et al., 2023).

Moreover, the current trends in the development of the livestock industry around the world provide for the introduction of systems in the industry that reduce the negative impact on the environment and ecology (Shahini et al., 2024). The main idea is to achieve the level of production equipment at which the maximum effect of reducing environmental pollution risks can be achieved and the social well-being of the population can be achieved. Omarov et al. (2021) describe the high potential for the introduction of “green energy”, provided through the use of renewable energy sources carried out through the processing of organic waste (heat, electricity, and biogas). Moreover, the introduction of such a system contributes to the achievement of part of the country’s energy and environmental goals. De Corato et al. (2018) talk about the high efficiency of the introduction of “green energy”, which consists of reducing the costs of fuel, heating, and electricity provided by bioenergy and is associated with accelerating the processes of sustainable development in the industry. However, the introduction of such systems, although they have high economic potential,

is very financially costly (Danchuk et al., 2015). In general, it is worth noting that the considered studies reflect the presence of positive trends in the world associated with the introduction of bioenergy in the agro-industrial complex, including the livestock industry. The Republic of Kazakhstan also considers bioenergy as an effective way to develop the industry and achieve environmental and economic efficiency in the future (Amanova et al., 2020). However, unfortunately, the industry is developing rather slowly in the current direction, which is associated with the high cost of reforming the production system of the livestock industry. For this reason, there is a need to find additional funds and alternative sources to increase the economic efficiency of the entire AIC and animal husbandry, in particular (Denissova et al., 2021).

The study by Jose and Dollinger (2019) considers the improvement in the quality of livestock care as a tool for improving the quality of products. The researchers emphasise that the quality of feed has a direct impact on the level of productivity of livestock. In turn, Kinley et al. (2020) talk about the need to provide animals and poultry with high-quality, environmentally friendly feed. The researchers note that when providing high-quality feed, the productivity of animals increases. As part of the current study, it was determined that the purchase of feed is not the only way to achieve the required level of feed, it is also advisable to increase the number of pastures in the country and maintain the necessary level of feedstocks through domestic production. Many modern researchers studying the issue of increasing the economic efficiency of animal husbandry see the need for the introduction of digitalisation in production and the establishment of an effective management system (Balehegn et al., 2020). Abdikadirova (2022) highlights the digitalisation of the agro-industrial complex as the main way of development. The introduction of digital technologies contributes to the improvement of the entire production process, starting with the purchase of feed and equipment and ending with the optimisation of the logistics system (Turmagambetova et al., 2017). In turn, the introduction of digitalisation in the livestock industry will increase the competitive potential of the country. Digitalisation contributes to the improvement of management, production, and logistics processes (Danchuk et al., 2021). At the moment, it is difficult to imagine production without digital management and control tools, therefore, one of the main tasks of the agro-industrial complex and the livestock industry, in particular, is the widespread introduction of digitalisation in all processes of the industry. Thus, seeing the need for the development of this area, the government of the country approved the Decree of the Government of the Republic of Kazakhstan No. 827 On approval of the State program “Digital Kazakhstan” (2017) (effective from December 2017 to May 2022), aimed at the development of the agro-industrial sector of the country through the introduction of automated systems in the industry.

Thus, the livestock industry of the Republic of Kazakhstan has a high development potential, having all the necessary factors to achieve efficiency, both production and economic. Within the framework of increasing the economic efficiency of animal husbandry in the Republic of Kazakhstan, the current level of development of the industry should be considered. Efficiency improvement will be possible if a modern approach to production management is introduced, the quality of animal care is improved, the livestock infrastructure is developed, and livestock production is supported by the state. These measures will create favourable conditions for the prosperity of animal husbandry and achieve its economic efficiency, which in turn will contribute to strengthening the economy of the Republic of Kazakhstan as a whole.

5 Conclusions

The study aimed to identify optimal pathways for enhancing the economic efficiency of the livestock industry in the Republic of Kazakhstan. Through comparative analysis, it became evident that the nation possesses significant potential for industry development, underscored by ample natural resources and favourable climatic conditions conducive to widespread agricultural activity, including livestock production. Moreover, the global trend towards integrating “green energy” into the agricultural sector emphasizes the importance of mitigating environmental impact, a consideration that aligns with international initiatives aimed at bolstering sustainability within the industry. Although such initiatives are promising, several impediments currently hinder their widespread adoption in Kazakhstan. These obstacles include the high costs associated with implementing innovative technologies, inadequate technical support, limited educational attainment among industry personnel, and insufficient investment.

Given the current landscape, short-term strategies are deemed more viable for enhancing economic efficiency within the livestock sector. These strategies encompass the implementation of educational programs, job creation, attracting investors, and providing governmental support through grants, tax incentives, and subsidies. Additionally, efforts to ensure a stable domestic supply of feed, enhance livestock welfare standards, and embrace digitalization are considered instrumental in driving immediate improvements. The resultant economic gains from these measures can then be reinvested to facilitate the eventual transition to bioenergy solutions, thereby fostering long-term sustainability.

In summary, the study underscores the promise of the livestock industry in Kazakhstan as a catalyst for economic growth and food security. By prioritizing efficiency enhancements and environmental stewardship, the nation can harness the industry’s potential to propel overall socioeconomic development. This entails a pragmatic approach that balances

immediate needs with the imperative of long-term sustainability, ensuring that Kazakhstan remains at the forefront of agricultural innovation while safeguarding its natural resources for future generations.

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