

**DIGITALIZATION OF LOGISTICS: NEW EXPORT OPPORTUNITIES FOR
THE MEAT INDUSTRY OF THE REPUBLIC OF KAZAKHSTAN**

**ЛОГИСТИКАНЫ ЦИФРАНДЫРУ: ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ
ЕТ ӨНЕРКӘСІБІНІҢ ЖАҢА ЭКСПОРТТЫҚ МҮМКІНДІКТЕРІ**

**ЦИФРОВИЗАЦИЯ ЛОГИСТИКИ: НОВЫЕ ЭКСПОРТНЫЕ ВОЗМОЖНОСТИ
МЯСНОЙ ПРОМЫШЛЕННОСТИ РЕСПУБЛИКИ КАЗАХСТАН**

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Abstract. *The objective* is to assess the impact of the digital transformation of logistics infrastructure on expanding the export potential of Kazakhstan's meat sector, with a focus on increasing the share of processed products and enhancing the industry's international competitiveness. *Methods* include a comprehensive set of methodological approaches ensuring a holistic study of the effects of logistics digitalization; calculation and design methods for determining relative indicators and preparing forecasts; statistical-economic methods for analyzing the dynamics of production processes and development trends in the meat processing industry; expert methods for monitoring the influence of institutional, technological, and market factors on sectoral competitiveness; and monographic methods for studying problematic aspects of livestock production under conditions of digital transformation of supply chains. *Results* – infrastructural and technical barriers constraining the expansion of exports of processed meat products are identified. Priority directions for modernization of the transport network are outlined, including the creation of regional agro-logistics hubs, digital platforms for supply chain management, and upgrading processing capacities. It is noted that the digital transformation of logistics mechanisms stimulates export expansion, contributes to reducing operational costs, strengthening quality and safety control of meat products, implementing IoT, blockchain technologies, and big data interpretation, and strengthening the country's position in the global meat market. *Conclusions* – an important role is played by stimulating

private sector participation in digital reform through targeted subsidies, tax incentives, and public-private partnership models. The implementation of effective measures will reduce transaction costs, enhance the competitive advantages of the meat cluster in external markets, and create conditions for long-term export-oriented brand promotion.

Аңдатпа. *Мақсаты* – қайта өңделген өнім үлесінің өсуіне және саланың халықаралық бәсекеге қабілеттілігін арттыруға баса назар аударып Қазақстанның ет секторының экспорттық әлеуетін кеңейтуге логистикалық инфрақұрылымның цифрлық трансформациясының әсерін бағалау. *Әдістер* – логистиканы цифрландырудың әсерін жан-жақты зерттеуді қамтамасыз ететін әдіснамалық тәсілдер кешені, есептік - конструктивті-сандық есептеулердің салыстырмалы көрсеткіштерін анықтау және болжамдар жасау кезінде, статистикалық - экономикалық-өндірістік процестердің динамикасын және ет өңдеу өнеркәсібінің даму тенденцияларын талдау үшін, сараптамалық - институционалды, технологиялық және нарықтық факторлардың салалық бәсекеге қабілеттілікке әсерін мониторингтеу кезінде, монографиялық - жеткізу тізбектерін цифрлық жаңарту жағдайында мал шаруашылығының проблемалық аспектілерін зерттеуді қамтамасыз етті. *Нәтижелер* - ет өңдеу өнімдерінің экспортын ұлғайтуды тежейтін инфрақұрылымдық және техникалық кедергілер анықталды. Өңірлік агрологиялық хабтарды, жабдықтау арналарын басқарудың цифрлық платформаларын құруды және қайта өңдеу қуаттарын жаңартуды қоса алғанда, көлік желісін жаңғыртудың басым бағыттары белгіленді. Логистикалық тетіктерді цифрлық түрлендіру экспорттық экспансияны ынталандыру болып табылады, операциялық шығыстарды төмендетуге, ет өнімдерінің сапасы мен қауіпсіздігін бақылауды күшейтуге, IoT блокчейн технологияларын енгізуге және үлкен деректерді түсіндіруге, республиканың әлемдік ет нарығындағы ұстанымын нығайтуға ықпал етеді. *Қорытындылар* - нысаналы субсидиялар, салықтық жеңілдіктер, мемлекеттік-жекешелік әріптестік модельдері есебінен жеке кәсіпкерліктің цифрлық реформаға қатысуын ынталандыру маңызды рөл атқарады. Пәрменді шараларды іске асыру транзакциялық шығындарды қысқартуға, сыртқы сауда алаңдарындағы ет кластерінің бәсекелестік артықшылықтарын арттыруға, оның брэндин ұзақ мерзімді экспортқа бағдарланған ілгерілетудің алғышарттарын қалыптастыруға мүмкіндік береді.

Аннотация. *Цель* – оценка влияния цифровой трансформации логистической инфраструктуры на расширение экспортного потенциала мясного сектора Казахстана с акцентом на рост доли переработанной продукции и повышение международной конкурентоспособности отрасли. *Методы* – комплекс методологических подходов, обеспечивающих всестороннее исследование эффектов цифровизации логистики, расчётно-конструктивный - при определении относительных показателей количественных расчётов и составлении прогнозов, статистико-экономический - для анализа динамики производственных процессов и тенденций развития мясоперерабатывающей промышленности, экспертный - при мониторинге воздействия институциональных, технологических и рыночных факторов на отраслевую конкурентоспособность, монографический - обеспечил изучение проблемных аспектов животноводства в условиях цифрового обновления цепей поставок. *Результаты* - выявлены инфраструктурные и технические барьеры, сдерживающие наращивание экспорта продуктов мясопереработки. Обозначены приоритетные направления модернизации транспортной сети, включая создание региональных агрологистических хабов, цифровых платформ управления каналами снабжения и обновление перерабатывающих мощностей. Отмечается, что цифровое преобразование логистических механизмов является стимулом экспортной экспансии, способствует снижению операционных расходов, усилению контроля качества и безопасности мясных изделий, внедрению технологий IoT блокчейна и интерпретации больших данных, укреплению позиций республики на мировом рынке мяса. *Выводы* – важную роль играет стимулирование участия частного предпринимательства в цифровому реформировании за счет целевых субсидий, налоговых льгот, моделей государственно-частного партнерства. Реализация действенных мер позволит сократить транзакционные издержки, увеличить конкурентные преимущества мясного кластера на внешних торговых площадках, формировать предпосылки долгосрочного экспортоориентированного продвижения его брэнда.

Keywords: agro-industrial complex, meat industry, processed meat products, logistics infrastructure, export potential, international trade, food security.

Түйінді сөздер: агроөнеркәсіптік кешен, ет саласы, өңделген ет өнімдері, логистикалық инфрақұрылым, экспорттық әлеует, халықаралық сауда, азық-түлік қауіпсіздігі.

Ключевые слова: агропромышленный комплекс, мясная отрасль, переработанная мясная продукция, логистическая инфраструктура, экспортный потенциал, международная торговля, продовольственная безопасность.

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Introduction

The digitalization of logistics infrastructure creates substantial opportunities to address existing structural constraints, enhance logistics processes, and optimize supply chain management. The adoption of advanced technologies such as automation, the Internet of Things (IoT), artificial intelligence (AI), and blockchain significantly improves transportation efficiency, reduces operational costs, and ensures product integrity throughout the logistics cycle, thereby contributing to the expansion of a country's export potential. In particular, digital transformation supports the modernization of cold chain systems, increases supply chain transparency, and mitigates logistics-related risks.

In 2025, the Ministry of Agriculture of the Republic of Kazakhstan implemented a set of measures aimed at expanding export markets and improving the efficiency of meat export logistics. These measures included the development of agrologistics infrastructure, the introduction of digital systems for veterinary certification and product traceability, the expansion of electronic export documentation through the "Single Window" mechanism, and the modernization of cold chain logistics. In addition, state support instruments were strengthened to stimulate investment in meat processing and logistics digitalization, as well as to facilitate access of domestic producers to foreign markets.

In 2024, exports of processed beef increased by 1.4 times, reaching more than 22 thousand tons, while lamb exports grew by 2.2 times to 18 thousand tons. These indicators were surpassed in 2025: from January to October, beef exports increased by 1.7 times compared to the previous year, amounting to 30.2 thousand tons, while lamb exports rose by 1.9 times to 25.5 thousand tons. This positive export dynamic is largely driven by sustained external demand for high-quality Kazakhstani meat products that meet international standards of quality and food safety.

This study examines the impact of digital technologies on the development of logistics infrastructure in Kazakhstan's meat industry, emphasizing their role in strengthening sectoral competitiveness and expanding export opportunities. Special attention is paid to key areas of digital transformation, including the

establishment of agrologistics hubs, the implementation of innovative solutions for supply monitoring and management, and the enhancement of coordination across logistics networks. Furthermore, the research analyzes the prospects and challenges associated with the digital transformation of the sector, taking into account institutional, technological, and market-related factors that influence the effectiveness of logistics modernization and export-oriented growth.

Against this background, the digitalization of logistics infrastructure is increasingly viewed as a strategic instrument for export-oriented growth. International experience demonstrates that digitally integrated logistics systems contribute to improved supply chain transparency, stronger trust among foreign partners, and higher compliance with global market standards. For Kazakhstan, the application of such approaches is especially relevant given its geographic location, export ambitions, and the need to enhance the value-added component of agricultural exports.

This study focuses on analyzing the impact of digital technologies on the development of logistics infrastructure in Kazakhstan's meat industry. It examines key directions of digital transformation, including the formation of agrologistics hubs, implementation of digital supply chain management platforms, and adoption of advanced monitoring technologies. The research also identifies major challenges and development prospects, assessing the role of logistics digitalization in enhancing competitiveness and expanding the export potential of the national meat industry.

Literature review

The meat industry in Kazakhstan has been increasingly influenced by the digitalization of logistics, which plays a crucial role in enhancing export potential. According to Nazarov V.F. [1] and Baizhanov A.Kh. [2], the integration of digital technologies such as IoT blockchain and big data allows for better monitoring of supply chains optimization of storage and transportation processes, improvement in product quality control. These innovations reduce operational costs and enhance efficiency, thus increasing competitiveness on international markets (Koshkarov K.N.; Sharipova Zh.N.) [3,4].

Several studies emphasize that successful implementation of digital solutions requires integration with external customs and logistics systems to minimize delays and streamline export processes (Smirnov I.V.) [5]. Moreover leveraging IoT technologies enables real-time tracking of temperature-sensitive products such as meat ensuring compliance with food safety standards and reducing spoilage risks (Ivanov D., Dolgui A.; Akkermans H., Van Wassenhove L.N.) [6,7] and (Li Y., Liu Y.) [8]. Research by Wójcicki K., Górna J., Sikorska E. [9] and Plakantara S.P., Karakitsiou A. [10] demonstrates that digital transformation also contributes to transparency in the supply chain, which is particularly critical for exporting to markets with strict safety requirements.

Additionally, studies show that Kazakhstan's logistics modernization positively affects the operational efficiency of meat processing enterprises and supports the growth of export volumes (Rakhmetova A.K.; Sharapova M.V.) [11,12] and (Dosmukhamedov K.Zh) [13]. Furthermore, international studies highlight the benefits of global best practices in logistics management and digitalization, providing guidance for Kazakhstan's meat industry modernization (Stanescu S.G.) [14], (Christopher M.) [15], (Rejeb A., Rejeb K., Abdollahi A. et al.) [16]. Finally, statistical data from the Bureau of National Statistics... [17] provide essential insights into trends in livestock production and meat export volumes, serving as a foundation for assessing the impact of logistics improvements on the industry.

Recent studies emphasize that the adoption of AI-driven logistics and predictive analytics can further optimize inventory management, transport routing, and cold chain monitoring, leading to reduced losses and higher product quality. Blockchain implementation ensures traceability from farm to fork, enhancing consumer trust and facilitating compliance with international standards. Moreover, digital platforms improve coordination among stakeholders, including producers, processors, and customs authorities, which is essential for efficient cross-border meat trade.

Pilot projects in Central Asia illustrate that digital solutions can accelerate export procedures, minimize bureaucratic obstacles, and provide real-time data for strategic decision-making. Consequently, digital logistics serves not only as a technological upgrade but also as a strategic tool to strengthen Kazakhstan's position in global meat markets, aligning with international trends toward sustainable and competitive agrifood exports.

Materials and methods

The study is based on a combination of quantitative and qualitative data sources aimed at assessing the impact of logistics infrastructure on the export potential of Kazakhstan's meat industry. Statistical data on meat production and exports were obtained from official reports of national authorities, including the Ministry of Agriculture of the Republic of Kazakhstan and the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

In addition, analytical materials and databases of international organizations, such as the World Bank and the Asian Development Bank, were used to provide a broader comparative and institutional context. Strategic policy documents related to the development of transport infrastructure and logistics corridors in Kazakhstan were also taken into account.

The methodological framework includes an analysis of official statistical reports to evaluate production dynamics, export volumes, and structural changes in the meat sector. A SWOT analysis was applied to assess the effectiveness of the existing logistics infrastructure by identifying internal strengths and weaknesses, as well as external opportunities and threats affecting export development. Economic modeling techniques were used to examine the relationship between logistics performance and export potential.

Furthermore, a case study approach was employed to conduct a comparative analysis of successful international practices in meat logistics and export development. To complement quantitative findings, expert interviews were conducted to obtain qualitative insights into the current state of logistics systems and their influence on export competitiveness. The integrated use of these methods ensures a comprehensive assessment of logistics infrastructure and logistics corridors and their role in enhancing the international competitiveness of Kazakhstan's meat industry.

Results

Analysis of the livestock and meat production data in Kazakhstan indicates mixed trends between 2020 and 2024. Total meat production by all types of farms decreased slightly, while the production of certain categories, such as horses, showed significant growth, reflecting shifts in internal demand and market strategies (Nazarov V.F.; Baizhanov A.Kh.) [1,2]. Meat processing enterprises play a pivotal role in ensuring export readiness. The largest processing companies, such as LLP "Meat Processing and Service" and JSC "KazAgroProduct" demonstrate how modernization and digitaliza-

tion contribute to reducing losses during storage and transportation, optimizing supply chains, and increasing export efficiency (Koshkarov K.N.; Smirnov I.V.) [3,5]. Moreover, implementation of digital platforms and smart logistics has shown economic benefits.

For instance improving infrastructure and logistics solutions can reduce transportation costs by 10–15% and decrease product losses from 5% to 2%, which translates into annual savings of up to \$20–30 million depending on the scenario (Rakhmetova A.K.; Sharapova M.V.) [11,12]. The study also found that only 45% of meat products were processed between 2020 and 2024, limiting value-added exports. Increasing the share of processed meat and modernizing production facilities will enhance competitiveness on international markets (Dosmukhamedov K.Zh.) [13]. In conclusion, the results underscore that the combination of digitalization, logistics optimization and

modernization of processing capacities is essential for increasing Kazakhstan's meat export volumes and ensuring sustainable growth in the sector (Sharipova Zh.N.) [4].

The meat industry of Kazakhstan represents an important sector of the country's agrarian economy. In recent years, there has been a steady growth in meat production and consumption; however, significant challenges related to export remain. Problems in logistics infrastructure, non-compliance of products with international quality standards, and transportation difficulties limit the potential for export growth. During the period 2020–2024, livestock and poultry production across all categories of farms in the Republic of Kazakhstan exhibited divergent trends, driven by both internal structural changes in the agricultural sector and external economic factors (table 1).

Table 1 – Volume of livestock and poultry production (live weight) and herd size in all categories of farms, thousand tonnes

Indicator	2020	2021	2022	2023	2024
Livestock and Poultry Production					
Total Production	2 058.5	2 162.2	1 800.1	1 920.3	1 995.3
including: cattle	1 001.3	1 039.0	737.8	771.5	830.6
sheep & goats	346.7	353.1	304.3	308.5	298.3
horses	276.3	292.5	303.6	323.8	330.9
pigs	124.4	119.7	80.8	79.3	72.1
camels	13.8	14.6	15.4	15.3	17.8
poultry	295.8	343.1	357.0	421.9	445.4
Livestock and Poultry Herd Size					
cattle	7 850.0	8 192.4	6 536.3	6 616.8	7 842.5
sheep & goats	20 057.6	20 876.8	18 843.0	18 667.4	20 175.0
horses	3 139.8	3 489.8	3 790.2	3 851.2	4 217.3
pigs	816.7	776.1	509.8	483.3	467.9
camels	227.7	243.4	253.7	264.9	281.5
poultry	43 335.0	47 884.7	45 653.1	44 174.2	45 175.4

Note: data compiled from the Ministry of Agriculture of the Republic of Kazakhstan and Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan

Table 1 shows that total livestock and poultry production in Kazakhstan decreased slightly from 2 058.5 tonnes in 2020 to 1 995.3 tonnes in 2024, a 3.1% decline, with a sharp drop in 2022 to 1800.1 tonnes, likely due to COVID-19 disruptions, logistics challenges, and rising feed costs. Beef production declined by 17% from 1 001.3 to 830.6 tonnes, with the largest reduction in 2022 (737.8 thousand tonnes), while sheep and goat production fell by 14% over the period. In contrast, horse meat production grew steadily by 19.8%, reaching 330.9 thousand tonnes in 2024, reflecting increased domestic demand and government support. Pork production decreased sharply by

42% from 124.4 to 72.1 thousand tonnes, possibly due to epizootic risks and changing consumer preferences.

Poultry production demonstrated stable growth, indicating sustained demand both domestically and internationally. Overall, the results highlight the differentiated dynamics across livestock sectors and underscore the importance of logistics modernization, digital transformation, and strategic investments to strengthen the competitiveness and export potential of Kazakhstan's meat industry.

According to the data presented in table 2, the total volume of meat production by all enterprises in the meat industry increased by 20.37% over the five-year period. The growth

in production volumes also reflects positive structural changes in the sector, including an increase in the share of beef and poultry. The rise in mutton and goat meat production indicates diversification of the meat sector and an expansion of the product range. Meat exports

demonstrate a steady upward trend, confirming the competitiveness of Kazakh products in international markets. This trend also points to improvements in product quality and the expansion of the industry's foreign economic activities.

Table 2 – Trends in Meat production in the Republic of Kazakhstan, thousand tons

Indicator	2019	2020	2021	2022	2023	2024
Meat production volume (thousand tons, carcass weight)	500	550	570	600	625	650
Beef (thousand tons, carcass weight)	200	250	260	280	290	300
Mutton and goat meat (thousand tons, carcass weight)	80	100	110	120	125	130
Poultry (chicken and turkey, thousand tons, carcass weight)	130	150	160	170	180	190
Pork (thousand tons, carcass weight)	50	50	55	60	65	70
Meat exports (thousand tons)	35	50	60	70	75	80

Note: compiled by the authors based on data from the (Bureau of National Statistics of the Agency...) [17]

The meat industry in Kazakhstan represents a dynamically developing sector. The country hosts large enterprises producing a wide range of meat products and meeting domestic consumption needs. The main large production facilities are presented in table 2 (Ivanov D., Dolgui A.) [6]. According to table 2, as of 2024, there are eight major meat industry

enterprises operating in the Republic of Kazakhstan, located in different regions and specializing in various types of production. All listed enterprises are key players in the Kazakh meat market, ensuring the domestic market is supplied with high-quality products while also exporting to foreign countries (table 3).

Table 3 – Major Meat Processing Enterprises of the Republic of Kazakhstan

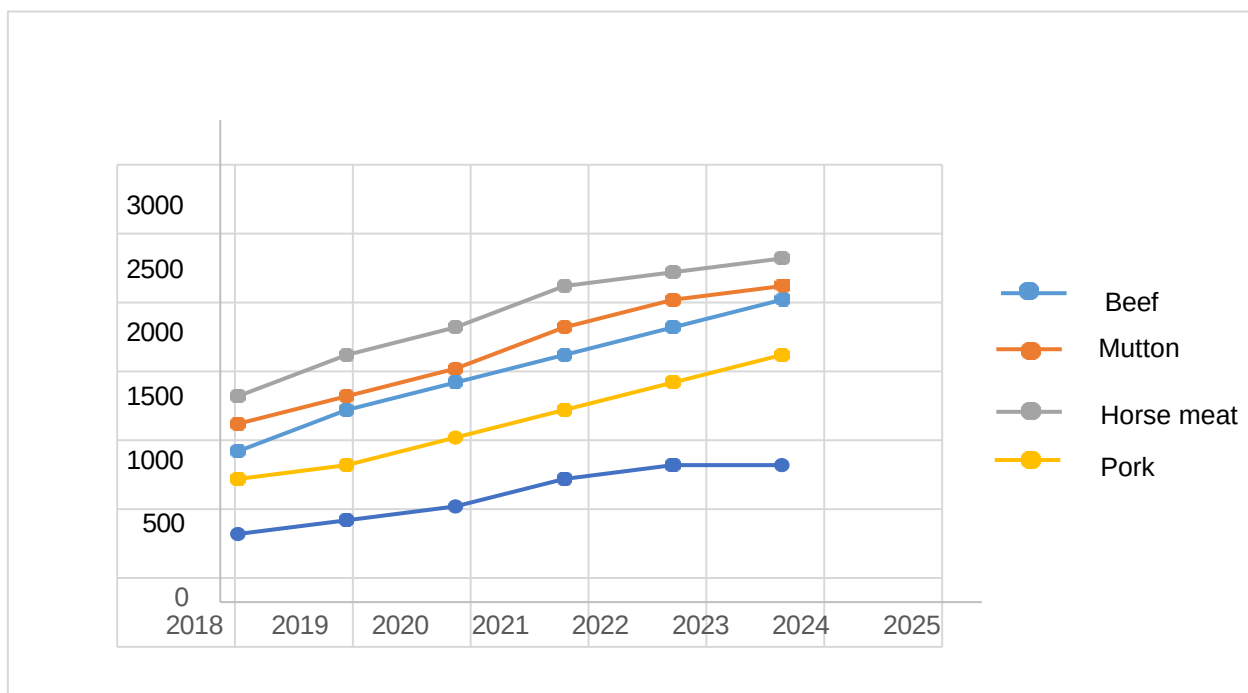
Enterprise name	Production capacity (tons/year)	Location (region)	Product range
LLP "Meat Processing and Service"	100.000	North Kazakhstan region	Beef. mutton. pork. meat semi-finished products
LLP "Aktobe Beef"	50.000	West Kazakhstan region	Beef. mutton. meat semi-finished products
JSC "KazAgroProduct"	60.000	Akmola region	Beef. mutton. meat semi-finished products
LLP "Apex Poultry Farm"	80.000	South Kazakhstan region	Poultry (chicken. turkey). meat semi-finished products
LLP «Empire of Meat»	55.000	East Kazakhstan region	Pork. beef. mutton
LLP "Kazakh Feed"	45.000	Almaty region	Beef. pork. compound feed
LLP "Astana Agro Product"	50.000	Akmola region	Beef. horse meat. mutton. meat semi-finished products

Note: compiled by the authors based on data from the (Bureau of National Statistics of the Agency...) [17]

Average consumer prices for meat in Kazakhstan have experienced a significant increase over the past five years. Figure presents data on the average prices of different types of meat across various years.

Digitalization of logistics processes is a critical driver of Kazakhstan's meat export growth. Technologies such as IoT, blockchain, big data, and AI enable automation of supply

chains, real-time monitoring of product quality, and enhanced transparency in product origin. These improvements increase operational efficiency, reduce logistics costs, and strengthen compliance with international food safety standards. As a result, Kazakhstan can expand its export volumes and values while enhancing the competitiveness of its meat products in global markets.



Note: compiled by the authors using official statistics from the (Bureau of National Statistics of the Agency...) [17]

Figure – Average consumer expenditure on different types of meat in Kazakhstan

Case studies from Kazakhstan demonstrate several successful applications of digital solutions in agrolistics. The use of IoT technologies for real-time monitoring of temperature conditions during meat transportation has improved product quality and reduced spoilage risks, thereby increasing trust in Kazakhstani exports. Another key measure is the integration of digital platforms with external customs and logistics systems, which reduces the time required for customs clearance and accelerates deliveries.

The economic impact of logistics digitalization is reflected in reduced operational costs, improved efficiency, and minimized losses through optimized resource use. Lower transportation and storage expenses enhance the financial performance of meat processing enterprises and strengthen their competitiveness in international markets. Despite significant opportunities, challenges remain. A shortage of qualified personnel capable of operating advanced technologies, high initial investment costs, and the need to modernize infrastructure are primary obstacles. Active participation of both public and private sectors in developing regulatory frameworks is essential to stimulate the adoption of digital logistics solutions.

Transportation costs are a critical factor influencing meat export prices. Currently, the average cost of transporting meat from Kazakhstan is approximately USD 0.12/kg to Russia and USD 0.18/kg to China, accounting for

logistical barriers, route complexity, certification requirements, and infrastructure limitations, including border delays. Improved infrastructure and more efficient logistics solutions are projected to reduce transport costs by 15%, lowering prices to USD 0.10/kg for Russia and USD 0.15/kg for China. In an optimistic scenario, a 20% improvement in logistics could further reduce costs to USD 0.096/kg and USD 0.144/kg respectively. Effective logistics also reduces product losses. Without a robust logistics system, losses during transport and storage can reach 5% of total exports. Implementation of an efficient cold chain can reduce losses to 2%, generating additional savings. For an export volume of 150.0 tonnes at an average price of USD 3/kg, reducing losses by 3% can save approximately USD 4.5–5.0 million annually. Storage costs, currently around USD 0.05/kg, can be reduced by 10–15% using modern refrigeration technologies, resulting in savings of USD 7.5–11.25 million per year.

Overall improvements in logistics, including route optimization, technology adoption, and loss reduction, can lower total logistics costs by 5–7%, equivalent to USD 20 million annually. More extensive improvements could achieve a 10–12% reduction, adding USD 30 million in savings per year. Reduced logistics costs and losses are expected to increase Kazakhstan's meat export volumes by 15–20 thousand tonnes annually, expanding the country's global market share by 2–3%.

Kazakhstan is actively developing transport corridors but faces challenges, including underdeveloped domestic networks, outdated equipment, and low standardization. Integration into international transport routes, such as the Trans-Caspian International Transport Route, is vital for reducing transit costs and enhancing external market competitiveness. Development of corridors like "China-Kazakhstan-Europe" will lower logistics costs and strengthen the global competitiveness of Kazakhstani meat. Addressing certification quality standards and foreign logistics network issues is essential for overcoming barriers to international meat exports. Development of international standards and improved certification infrastructure are key measures for ensuring successful market access.

Analysis of logistics costs and export potential of Kazakh meat products according to the analysis of logistics costs for major Kazakh meat processing enterprises shows that transportation accounts for approximately 25% of the total cost of products for export deliveries. The average cost of transporting meat to Russia is about USD 0.12 per kilogram. Exporting to China incurs higher costs, approximately USD 0.18 per kilogram, due to the more complex logistics network and additional certification requirements.

Impact of infrastructure improvements on export potential modeling conducted in this study demonstrates that optimizing logistics chains can significantly influence the dynamics of meat exports. Specifically, improvements in infrastructure and logistics processes, including the development of transport corridors and the adoption of modern logistics solutions, are projected to increase export volumes by 12–15% per year over the next five years. This growth is associated with reduced transit costs and faster delivery times, which enhance the international competitiveness of Kazakh meat products.

Current export growth rates (4–6% per year) do not fully reflect the sector's potential. Reducing logistics costs through the implementation of new technologies and route optimization - particularly a 15% reduction in transportation expenses - can decrease overall logistics expenditures by 5-7%. This, in turn, will improve the financial performance of meat processing enterprises and increase their competitiveness in foreign markets.

Meat processing and its effect on export: an important finding of the study is the low level of meat processing. From 2020 to 2024, only 45% of total production consisted of processed

meat products. This limits the added value of exported products and reduces their attractiveness in international markets where quality and product assortment requirements are high. Increasing the share of processed products and modernizing processing capacities will not only improve product quality but also significantly expand export volumes. Reducing dependence on raw meat exports and increasing processed product output will open new markets and enhance the added value of Kazakh meat, which is a critical economic factor for sustainable export growth.

Barriers to export and infrastructure challenges. Key barriers to successful meat exports include underdeveloped domestic logistics networks, outdated equipment, and low standardization levels. These factors lead to high transit costs and increased prices in foreign markets. Importing countries impose strict requirements on storage and transportation conditions, highlighting the need for an effective cold chain system. Currently, existing cold storage and transport capacities do not meet these standards, limiting export potential.

Integration into international transport networks is another crucial challenge for Kazakhstan. Implementing more efficient and high-quality logistics solutions along existing transport corridors, such as the "China-Kazakhstan-Europe" route, can reduce logistics costs, improve product handling, and increase export potential.

Conclusion based on the study's findings: the development of logistics infrastructure will be a key factor in enhancing the international competitiveness of Kazakh meat. Significant investments in modernizing the sector are required; however, modeling and forecasting indicate that these investments will generate substantial economic benefits in the medium term.

Discussions

The analysis of the meat industry in Kazakhstan demonstrates that the development of logistics infrastructure, digitalization, and modernization of processing capacities are critical factors influencing export performance and sectoral competitiveness. Despite steady growth in production volumes between 2020 and 2024, the export potential of the industry is constrained by limited processing levels, insufficient cold chain infrastructure, and high transportation costs. Only 45% of meat production is processed, which limits added value and reduces competitiveness in international markets that demand high-quality, diversified products. As shown in table 4, the main priorities include:

Table 4 - Key directions for improving state measures on the digitalization of meat export logistics in Kazakhstan

Policy direction	Description of measures	Expected economic impact
Integrated digital platforms	Systematic integration of digital platforms across all stages of meat export logistics from production to international distribution	Improved coordination and efficiency of export supply chains
Digital traceability systems	Implementation of unified digital traceability tools to monitor product origin quality and compliance with international standards	Increased transparency and trust among foreign trade partners
Customs and certification digitalization	Automation of customs clearance procedures. expansion of electronic veterinary certificates and use of single-window systems	Reduction in export timeframes and transaction costs
State support and PPP mechanisms	Provision of subsidies. tax incentives. and public-private partnerships to stimulate private sector involvement in logistics digitalization	Increased investment activity and technological adoption
Competitiveness enhancement	Alignment of national digital logistics systems with international platforms and standards	Strengthening the global competitiveness of Kazakhstan's meat exports
Note: prepared by the authors		

Conclusion

1. *Integrated digitalization of export logistics.* The improvement of state measures for the digitalization of meat export logistics chains in Kazakhstan requires the systematic integration of digital platforms across all stages of product movement, from primary production to international markets.

2. *Digital traceability and quality control.* A key priority is the implementation of unified digital traceability systems that ensure supply chain transparency, effective quality control, and compliance with international veterinary and sanitary standards.

3. *Customs and certification automation.* Government policy should focus on further automation of customs procedures, including the expansion of electronic certification and the use of "Single Window" systems in export operations.

4. *State support and public-private partnership.* An important role is played by stimulating private sector participation in logistics digitalization through targeted subsidies, tax incentives, and public-private partnership mechanisms.

5. *Economic and competitiveness effects.* The implementation of these measures is expected to reduce transaction costs, increase the efficiency of export logistics, and enhance the international competitiveness of Kazakhstan's meat products.

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