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LOGISTICS MANAGEMENT SYSTEMS AS A CONDITION FOR INCREASING THE COMPETITIVENESS OF AGRICULTURAL PRODUCTS OF THE REPUBLIC OF KAZAKHSTAN

МЕНЕДЖМЕНТТІҢ ЛОГИСТИКАЛЫҚ ЖҮЙЕЛЕРІ ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ АГРАРЛЫҚ ӨНІМІНІҢ БӘСЕКЕГЕ ҚАБІЛЕТТІЛІГІН АРТТЫРУ ШАРТЫ РЕТІНДЕ

ЛОГИСТИЧЕСКИЕ СИСТЕМЫ МЕНЕДЖМЕНТА КАК УСЛОВИЕ ПОВЫШЕНИЯ КОНКУРЕНТОСПОСОБНОСТИ АГРАРНОЙ ПРОДУКЦИИ РЕСПУБЛИКИ КАЗАХСТАН

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Abstract. The study of the logistics component in the agro-industrial complex is a relevant task not only for the economy of the republic but also for most countries of the world. Logistics in agriculture is becoming increasingly important, as it relates to uninterrupted delivery of food from producer to consumer. *The objective* is a comprehensive analysis of the current state of the agricultural sector of the Republic of Kazakhstan with a focus on diagnosing problems and assessing the potential of logistics management as a strategic factor for increasing competitiveness and export potential. *Methods* include structural diagnostics of changes in sown areas and livestock numbers, comparative analysis to assess the dynamics of indicators for 2020–2024 against target parameters, and system and content analysis of documents to identify relationships between production diversification, logistics infrastructure, and state support measures, as well as transformations in crop and livestock production and the functioning of the agrologistics mechanism. *Results* reveal systemic constraints in the development of the agro-industrial complex, among which high logistics costs and significant product losses in supply chains are dominant. Problem areas of logistics management are identified and systematized into three areas (infrastructure, digitalization, and supply chain regulation). The need to transition from a fragmented logistics approach to the creation of integrated digital platforms and hubs is substantiated. *Conclusions* show that modernization of Kazakhstan's agro-industrial production and realization of its export potential are impossible without fundamental reform of the commodity flow system. Thus, optimization of logistics processes in the agro-industrial complex is a necessary condition for enterprise functioning, strengthening market competitiveness, maximizing profits, and reducing costs.

Аңдатпа. АӨК-дегі логистикалық компонентті зерттеу тек республика экономикасы үшін ғана емес, әлемнің көптеген елдері үшін де өзекті міндет болып табылады. Ауыл шаруашылығындағы Логистика барған сайын маңызды бола түсуде, өйткені ол өндірушіден тұтынушыға үздіксіз азық-түлік жеткізілімін білдіреді. *Мақсаты* – проблемаларды диагностикалауға және логистикалық менеджменттің әлеуетін оның бәсекеге қабілеттілігі мен экспорттық әлеуетін арттырудың стратегиялық факторы ретінде бағалауға бағдарлана отырып Қазақстан Республикасының аграрлық секторының қазіргі жай күйін жан-жақты қарау. *Әдістер* – егіс алқаптары мен мал басын трансформациялаудың құрылымдық диагностикасы, 2020-2024 жылдар көрсеткіштерінің динамикасын нысаналы параметрлермен салыстыру үшін салыстырмалы зерттеу, өндірістік әртараптандыру, логистикалық инфрақұрылым және мемлекеттік қолдау шаралары, сондай-ақ өсімдік шаруашылығы мен

мал шаруашылығындағы сындарлы қайта құрулар, агрологиялық тетіктің жұмыс істеу дәрежесі арасындағы өзара байланыстарды анықтау кезінде құжаттарды жүйелі және контент-талдау. *Нәтижелер* - агроөнеркәсіптік кешенді дамытудың жүйелі шектеулері көрсетілген, олардың арасында жоғары логистикалық шығындар және жеткізу тізбегіндегі өнімнің айтарлықтай шығындары басым. Логистикалық басқарудың проблемалық аймақтары үш бағыт бойынша (инфрақұрылым, цифрландыру, жабдықтау желісін реттеу) айқындалды және жүйеленді. Интеграцияланған цифрлық платформалар мен хабтарды құруға фрагменттелген логистикалық тәсілден көшу қажеттілігі негізделген. *Қорытындылар* - Қазақстандық агроөнеркәсіптік өндірісті жаңғырту және оның экспорттық ресурстарын сату тауар ағындары қозғалысының жүйесін түбегейлі реформалаусыз мүмкін еместігі анықталды. Осылайша, агроөнеркәсіптік кешендегі логистикалық процестерді оңтайландыру кәсіпорынның жұмыс істеуі, оның нарықтағы бәсекеге қабілеттілігін арттыру, шығындарды азайту кезінде алынған пайданы барынша арттыру шеңберіндегі қажетті шарт болып табылады.

Аннотация. Изучение логистической составляющей в АПК – актуальная задача не только для экономики республики, но и для большинства стран мира. Логистика в сельском хозяйстве приобретает все большее значение, поскольку она относится к бесперебойным поставкам продовольствия от производителя к потребителю. *Цель* – всестороннее рассмотрение современного состояния аграрного сектора Республики Казахстан с ориентиром на диагностику проблем и оценку потенциала логистического менеджмента как стратегического фактора повышения его конкурентоспособности и экспортного потенциала. *Методы* – структурная диагностика трансформации посевных площадей и поголовья скота, сравнительное исследование для сопоставления динамики показателей 2020–2024гг. с целевыми параметрами, системный и контент-анализ документов при выявлении взаимосвязей между производственной диверсификацией, логистической инфраструктурой и мерами государственной поддержки, а также конструктивных преобразований в растениеводстве и животноводстве, степени функционирования агрологистического механизма. *Результаты* - показаны системные ограничения развития агропромышленного комплекса, среди которых доминирующими являются высокие логистические издержки и значительные потери продукции в цепочках доставки. Определены и систематизированы по трем направлениям (инфраструктура, цифровизация, регулирование сети снабжения) проблемные зоны логистического управления. Обоснована необходимость перехода от фрагментированного логистического подхода к созданию интегрированных цифровых платформ и хабов. *Выводы* - установлено, что модернизация казахстанского агропромышленного производства и реализация его экспортных ресурсов невозможны без коренного реформирования системы движения товарных потоков. Таким образом, оптимизация логистических процессов в АПК необходимое условие в рамках функционирования предприятия, усиления его конкурентоспособности на рынке, максимизации получаемой прибыли при сокращении издержек.

Keywords: agro-industrial complex, crop production, livestock production, logistics management, supply chain optimization, integrated logistics hubs, digitalization, export potential.

Түйінді сөздер: агроөнеркәсіптік кешен, өсімдік шаруашылығы, мал шаруашылығы, логистикалық менеджмент, жеткізу тізбегін оңтайландыру, интеграцияланған логистикалық хабтар, цифрландыру, экспорттық әлеует.

Ключевые слова: агропромышленный комплекс, растениеводство, животноводство, логистический менеджмент, оптимизация цепочек поставок, интегрированные логистические хабы, цифровизация, экспортный потенциал.

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Introduction

In the context of accelerating globalization of food markets, tightening consumer and regulatory requirements for product quality, safety, and traceability, as well as against the backdrop of intensifying climate change and geopolitical turbulence, the traditional competitive advantages of the agricultural sector - founded upon extensive land resources and low production costs-are becoming insufficient to ensure long-term sustainable competitiveness. Modern competition in agribusiness is increasingly unfolding not within fields or on farms, but rather in the sphere of value chain efficiency, where logistical management plays a decisive role. It is transforming from an auxiliary operational function into a strategic pivot that determines the effectiveness of the entire agro-industrial complex (AIC) - from primary production to the end consumer. Its

key objective is the minimization of aggregate losses - physical, temporal, and monetary -and the optimization of costs throughout the entire product movement path, which directly impacts profitability, product availability, and demand satisfaction.

For the Republic of Kazakhstan, which possesses a unique combination of factors - namely, a colossal territory, a landlocked continental location remote from key seaports, and a sharply continental climate -the task of building a modern, smart, and highly efficient logistical system is elevated to the status of a strategic imperative on a national scale. Success in this direction is vital for the simultaneous resolution of three fundamental tasks: guaranteeing national food security by reducing losses and ensuring product availability across all regions; substantially increasing the profitability and resilience of agricultural producers by reducing the share of logistical costs in their final revenue; and qualitatively expanding non-resource exports with high added value.

The relevance of this topic is underscored by the structural transformation occurring within the Kazakhstan agro-industrial complex itself. The sector is gradually but steadily diversifying: its mono-dependence on wheat is declining, the areas allocated to oilseeds, vegetables, fruits, and berries are expanding, and livestock farming is undergoing intensive development. This more diversified product basket fundamentally alters logistics requirements. While grain is relatively tolerant of long-term storage and bulk transportation, perishable products require an advanced cold chain, precise timing coordination, specialized containers and packaging, as well as expedited customs procedures. Consequently, the existing logistical model, historically shaped to meet the needs of grain exports, has entered into a sharp contradiction with the demands of diversifying production.

Literature review

Systematization of current publications allows for the identification of several interrelated directions that form the theoretical basis for this study. Research dedicated to logistics in transit economies is gaining particular relevance in light of geopolitical shifts (Beifert A.) [1], in a work focused on the Eastern Partnership countries, analyzes the impact of disruptions to traditional logistical corridors on agricultural exports. The author emphasizes the necessity of developing multimodality and diversifying routes as a strategic response to increasing risks, which is of direct interest to Kazakhstan as it seeks alternative pathways for its products to reach global markets.

Blockchain technologies have transitioned from the stage of conceptual discussion to the realm of practical implementation in a systematic review (Kumar A., Shrivastava R. L.) [2], analyze successful cases of using blockchain platforms to ensure immutable end-to-end traceability of agricultural products. The authors highlight key benefits: the reduction of transaction costs and compliance with strict international market requirements regarding the origin and quality of products. This is particularly relevant for Kazakhstan, which exports organic products. The implementation of artificial intelligence and big data to optimize logistical operations is another critical area. Research in this direction focuses on the measurable results of applying advanced analytical tools (Tsolakis N., Zissis D., Papaefthimiou S.) [3] develop and test an AI-based model for dynamic inventory management and routing in perishable food supply chains.

The specific challenge of maintaining the quality of perishable goods is addressed through integrated technological solutions (Li J., Wang Y.) [4], propose an architecture for intelligent cold-chain logistics, where IoT sensors transmit real-time data on temperature and humidity, while blockchain records this information to ensure transparency at all stages. Chen L., Zhang D. [5] develop a mathematical model to optimize multimodal routes for transporting agricultural products, taking into account tariffs, delivery times, and carbon footprints. The model allows for finding a balance between economic efficiency and environmental responsibility, which is critically important for Kazakhstan.

Research acknowledges that technological innovations fail without organizational changes (Rodriguez J.A., Gómez M.) [6], based on the analysis of numerous cases, identify key factors: leadership, digital culture, the availability of IT infrastructure, and staff retraining. The authors emphasize that success is determined not by an individual technology but by the organization’s ability to adapt its business processes to it.

Recent experience has highlighted the importance of risk management (Wang S., Liu Y.) [7], propose a framework for the quantitative assessment of supply chain resilience and model scenarios for enhancing stability through supplier diversification.

Materials and methods

The research methods include structural analysis to assess changes in crop areas and livestock populations. Furthermore, compara-

tive analysis is utilized to compare key logistical indicators for the 2020–2021 period with the target values for 2024–2025.

Structural analysis was applied to identify qualitative and quantitative transformations within the agro-industrial complex. The method was used to evaluate the dynamics of crop area structures (the ratios of grains, oilseeds, vegetables, etc.) and changes in the species structure of livestock.

Comparative analysis (the comparative method) served as the primary tool for diagnosing the effectiveness of logistical management. The method was implemented in two key aspects: first, through temporal comparison - contrasting baseline performance indicators of agricultural logistics (cost levels, losses, customs clearance times) for the 2020–2021 period with the prospective target values set for 2024–2025.

Systems analysis became the central method for integrating disparate data and forming a comprehensive overview. Its application enabled a diagnosis of the complex interconnections and feedback loops between three key subsystems.

Content analysis of documents was applied to process qualitative information contained in government programs, reports, and strategies. This allowed for the extraction of key priorities and declared policy instruments, as well as the recording of shifts in rhetoric and approaches to logistical management within the agro-industrial complex.

Results

The data analysis for the 2022–2024 period confirms that Kazakhstan's agro-industrial complex is operating in a mode of steady but moderate dynamics, characterized by pronounced internal structural changes. According to preliminary estimates for the end of 2024, the share of the AIC in the country's Gross Domestic Product (GDP) remained at approximately 4.7%, continuing a long-term stabilization trend against the backdrop of overall economic growth. At the same time, the sector's absolute volumes demonstrate positive dynamics: the growth of gross agricultural output in 2024 is estimated at approximately 3.0%. This growth is driven not by extensive expansion but by qualitative transformation, a key trend of which is the outpaced development of livestock farming alongside active diversification in crop production.

These trends have a direct and significant impact on logistics, shaping new requirements for supply chain management. The most telling indicator of this transformation is the dynamics of crop area structures, which demonstrate a systemic shift away from the traditional grain monoculture (table 1).

Table 1 – Dynamics of Crop Area Structures in Kazakhstan (thousand hectares)

Crop Type	2022	2023	2024	Logistical Challenge
Grains (total)	15 200	14 900	14 700	Bulk transportation, grain elevators
Oilseeds	3 000	3 300	3 650	Spoilage prevention, specialized storage
Vegetables and potatoes	500	520	560	Cold chain, urgent delivery
Fruits and berries	120	135	155	High requirements for packaging and temperature
Note: compiled by the authors based on the analysis of structural transformations in the crop sector and logistical requirements for specialized storage (Skiba R.; Bjerke L., Johansson S.) [8, 9]				

As shown in table 1, there is a consistent reduction in grain crop areas alongside steady growth in more marginal and logistically demanding categories. Oilseed areas have grown by more than 20% over the three years, creating a need not only for increased transportation volumes but also for specialized storage conditions to prevent spoilage and maintain the quality of oilseeds. However, from a logistical management perspective, the most significant developments are the outpaced growth rates in the vegetable and horticulture segments.

The expansion of areas dedicated to vegetables, potatoes, fruits, and berries - even with relatively small absolute values – generates a qualitatively different type of freight flow (Skiba R.) [8]. These products are characterized by a high degree of perishability, seasonal peak loads, and a critical dependence on temperature control. Thus, production diversification directly generates a demand for a transition from the logistics of bulk, homogeneous, and stable cargo (grain) to the logistics of segmented, sensitive, and urgent cargo. This shift necessitates a radical restructuring of infrastructure, transport fleets, and management processes (Bjerke L., Johansson S.) [9].

Steady growth in crop production is complemented and even slightly outpaced by positive dynamics in livestock farming, which together pose a comprehensive challenge to the logistical system. The increase in livestock and poultry populations directly translates into rising production volumes of meat, milk, eggs,

and other animal-derived products, which impose even more stringent requirements on storage and transportation conditions.

While crop production primarily requires solving "cold chain" issues for preservation, livestock products add the critically important component of veterinary-sanitary safety and traceability (Stukach V.F., Baidalinova A.S., Suleimanov R. E.) [10]. To access high-margin export markets (such as China, the Persian Gulf countries, and the EU), it is necessary not only to ensure seamless refrigerated logistics but also to guarantee documented and digital traceability of each product batch's origin, back to the specific farm of production. This imperative makes the development of livestock logistics not merely a matter of economic efficiency but a mandatory condition for entering new markets.

The livestock population dynamics presented in table 2 clearly illustrate the scale of the emerging freight flow.

Table 2 – Livestock and Poultry Populations in Kazakhstan (as of January 1, 2025, thousand heads)

Animal Type	2023	2024	2025
Cattle	8 050	8 350	8 650
Sheep and Goats	20 100	20 800	21 500
Poultry	48 000	49 500	51 000
Note: compiled by the authors based on the monitoring of livestock development indicators and food security parameters in the Republic of Kazakhstan (Stukach V.F., Baidalinova A.S., Suleimanov R.E.; Satybaldin A.A., Tleuberdinova A.T., Kulik K.V.) [10, 11]			

Based on the information presented in table 2, it can be concluded that the growth in livestock populations directly drives an increase in meat and dairy product flows, which require a well-developed cold chain and traceability systems.

An analysis of the diagnostic state of logistical management reveals persistent systemic issues:

- high costs: the share of logistical expenses in the cost of final products in remote regions reaches 35–45%;
- critical losses: the level of vegetable and fruit losses within the supply chain is estimated at 20–25% as of the end of 2024;
- infrastructure deficit: a shortage of modern storage capacities for perishable goods and seasonal congestion of grain elevators.

Furthermore, it can be stated that steady growth in livestock populations creates not only a quantitative but also a qualitative challenge for logistics. The projected increase in cattle, sheep, and poultry populations directly drives growing and less predictable flows of meat and dairy products, which impose exceptionally high requirements on a continuous cold chain at all stages -from primary processing and storage to transportation and distribution. Concurrently, access to premium export markets and compliance with modern safety standards necessitate the implementation of comprehensive electronic traceability systems capable of tracking the origin and movement of each batch of raw materials in real-time (Satybaldin A.A., Tleuberdinova A.T., Kulik K.V.) [11].

Thus, the production successes in livestock farming, supported by the data in the table, bring long-standing and unresolved logistical challenges to the forefront. This creates a paradoxical situation where the growth of production potential does not translate into a proportional increase in export revenue and producer profitability due to systemic constraints in the areas of delivery and marketing.

The diagnostic analysis of the sector reveals a roadmap for the systemic modernization of the country's agro-logistical framework. To understand the transition from the current infrastructure to a high-tech export-oriented model, it is necessary to examine the specific benchmarks set by the government and private sector. The shift toward reducing inefficiencies and adopting digital oversight is detailed in table 3.

Table 3 – Comparative Performance Indicators of Agricultural Logistics in Kazakhstan

Key Indicator	2020–2021 actual	2024–2025 target	Implementation Tools (as of 2024)
Share of logistical costs in prime cost	35-40%	< 30%	Digital freight exchanges, cargo consolidation.
Loss level (perishables)	25-30%	< 18%	Construction of refrigerated terminals in Almaty and Shymkent.
Average customs clearance time	48-72 ч.	< 24 ч.	Expansion of the "Single Window" pilot project.

Share of exports with electronic traceability	<10%	> 40%	Enhancing the state "Sana" Information System for livestock traceability to ensure digital tracking of meat export batches.
Freight transport utilization coefficient	0.60	0.75	Launch of the National Digital Logistics Platform.
Note: compiled by the authors based on the performance benchmarks of logistical companies and state infrastructure development targets (Zhebe Logistics Company; Prime Minister of the Republic of Kazakhstan...) [12, 13]			

The presented targets and implementation tools for 2024–2025 form a comprehensive roadmap for the modernization of Kazakhstan's agricultural logistics. The key strategy is the parallel development of physical infrastructure (refrigerated terminals) and digital ecosystems (the national platform, "Sana" system integration and the "Single Window"). Successful implementation of these initiatives will enable a qualitative leap: reducing costs and losses, which will directly increase producer profitability, while simultaneously creating a high-tech, transparent, and rapid logistical service -a prerequisite for the export growth of high-margin products. Consequently, logistics is being transformed from a bottleneck into a driver of value-added for the entire agro-industrial complex (Zhebe Logistics Company) [12].

Attention should be drawn to the ongoing initiatives and innovations. Regarding infrastructure: in 2024, the construction of five regional logistical hubs is underway, involving both state participation and private capital. Furthermore, the modernization program for the grain elevator fleet continues.

Digitalization: a pilot project for blockchain-supported organic wheat exports has been launched. Additionally, the use of IoT sensors is expanding in refrigerated fruit transportation to China.

State Support: a new subsidy has been introduced, providing compensation for up to 30% of transport logistics costs for the export of deep-processed products (Results of the “Nurly Zhol” program...) [13].

The empirical evidence presented in the dynamics of crop and livestock sectors suggests that Kazakhstan’s AIC is at a critical transition point. The shift from a grain-based economy to a high-value diversified model creates a specific logistical pressure that the current infrastructure is only beginning to assimilate. The diagnostic analysis indicates that the effectiveness of the proposed roadmap depends on the synergistic interaction between regional hub connectivity, digital transparency, and economic incentivization. The expansion of vegetable and fruit areas, which demonstrated significant growth over the three-year period, has revealed a sharp regional imbalance where production is concentrated in the southern and southeastern regions while the primary consumption and export nodes remain geographically distant. Current loss levels for perishable products, reaching 25–30%, are largely attributed to the lack of regional capacities for rapid cross-docking processing.

In this regard, the construction of refrigerated terminals in Almaty and Shymkent acts as a strategic buffer that allows for the stabilization of the cold chain and the consolidation of small batches from fragmented farms into standardized export lots. This regional consolidation is the only viable path to reducing the share of logistical costs in prime cost from the current 40% to the targeted level of less than 30%, as it optimizes transport utilization and minimizes the problem of empty return runs. Simultaneously, the data regarding livestock populations poses a qualitative challenge that cannot be solved by traditional logistical methods alone. With the projected growth of cattle and poultry populations by 2025, the volume of generated biological data becomes immense, making the transition to electronic traceability through the "Sana" system a technical entry ticket to premium markets in the European Union and the Middle East.

The implementation of blockchain systems to monitor veterinary checks and temperature fluctuations during transit ensures data immutability and increases the level of trust among international buyers. The results obtained suggest that every 10% increase in digital traceability coverage correlates with growth in the average export price, as it transforms Kazakhstani products from a mass raw commodity into a branded, high-quality product. Furthermore, the effectiveness of the introduced 30% subsidies for transport costs of deep-processed products reaches its maximum potential only when integrated with the National Digital Logistics Platform. Small-scale producers of oilseeds, whose areas have grown by hundreds of thousands of hectares, often lack the ability to independently negotiate competitive freight rates.

Digital freight exchanges allow these producers to participate in a cargo consolidation model, pooling demand and gaining

access to the same transport preferences enjoyed by large agricultural holdings. This democratization of logistics is a necessary condition for sustainable income growth across the entire agricultural sector, ensuring that the 3.0% growth in gross output translates into actual profit for the rural population. Ultimately, the roadmap to 2025 recognizes that physical infrastructure in the form of roads and warehouses must be supplemented by intelligent management systems. The modernization of the grain elevator fleet, along with the integration of IoT sensors into refrigerated transport, represents a hybrid approach to cargo flow management. The ability to switch between rail and road transport based on data from the "Single Window" pilot project increases the sector's resilience to geopolitical and climatic challenges.

The integration of advanced logistical management into the Kazakhstani agro-industrial complex also addresses the critical issue of "hidden" economic losses. Current analysis shows that the 20–25% loss level in the vegetable and fruit segments (as of 2024) is not only a physical loss of product but a massive drain on the financial liquidity of small and medium farms. By establishing the proposed network of regional logistical hubs, the sector can shift toward a "just-in-time" delivery model, which minimizes the need for long-term storage and reduces the associated energy costs. This transition is particularly vital for the export of high-margin crops like berries and stone fruits, where every hour of delay decreases the final market price.

Furthermore, the data regarding the utilization of freight transport suggests a significant untapped potential for cost optimization. A freight utilization coefficient of 0.60 indicates that nearly 40% of transport capacity is wasted due to poor coordination and lack of real-time data. The implementation of the National Digital Logistics Platform will enable dynamic routing and back-haul load matching, effectively lowering the carbon footprint of agricultural exports while increasing the profitability of transport companies. This systemic improvement is expected to bridge the gap between rural producers and international distribution centers, creating a seamless "farm-to-fork" pipeline that is resilient to seasonal fluctuations.

The strategic roadmap also emphasizes the importance of multimodal synergy, where rail transport handles the long-haul bulk exports of grains and oilseeds, while specialized road transport manages the agile delivery of perishable animal products. This balanced approach ensures that Kazakhstan can leverage its landlocked position as a transit advantage rather than a geographic constraint. As the "Single Window" project expands, the reduction in administrative barriers will complement the physical infrastructure, allowing for a 30% increase in the throughput capacity of existing border crossings by 2025. This comprehensive transformation turns logistical efficiency into a core competitive advantage for Kazakhstani agribusiness on the global stage.

Discussions

The obtained results indicate a profound contradiction between the diversifying structure of the agro-industrial complex and the outdated logistical model, which remains focused on bulk, non-perishable cargo. Despite positive shifts (table 3), the 2024–2025 targets remain ambitious and demand an unprecedented coordination of efforts. A key systemic risk is the fragmented implementation of innovations: isolated digital pilot projects and localized infrastructure objects are often not integrated into a unified operational and information ecosystem. This creates "digital gaps" in supply chains, where data cannot flow seamlessly from the farmer to the carrier, customs broker, and final buyer, thereby negating the potential efficiency of each individual solution.

Beyond the infrastructural and digital dimensions, the transition toward a value-added export model necessitates a fundamental shift in how transport corridors are utilized within Kazakhstan’s vast territory. The current reliance on bulk logistics often leaves small and medium-sized producers isolated from high-margin markets due to prohibitive "last-mile" costs. Integrating regional consolidation hubs - acting as multimodal "dry ports" - is essential to aggregate cargo and achieve the economies of scale required for global competitiveness. These centers should provide not only storage but also specialized services such as automated grading and cold-chain management, effectively transforming geographical distances from a logistical burden into a managed strategic asset.

Furthermore, the "digital gaps" identified in the study point to a deeper need for standardized data protocols across the entire agro-industrial ecosystem. The existing fragmentation arises because disparate platforms used by customs, transport authorities, and private farmers lack interoperability. Adopting a "digital thread" approach - utilizing blockchain-based tracing or unified digital bills of lading - would ensure that quality certifications and

phytosanitary data flow seamlessly alongside the physical product. This level of transparency is no longer a luxury but a prerequisite for entering high-value international markets, where data-driven trust is as critical as the quality of the goods themselves.

The discussion in the context of the literature review shows that Kazakhstan is following the path of many agricultural nations, where logistics becomes a critical bottleneck during the transition from raw material exports to the production of high-value-added goods. However, the Kazakhstani context is exacerbated by the factors of transit potential and territorial scale, which raises the stakes and demands more comprehensive solutions. The state-proposed measures (stimulating cooperation for cargo flow consolidation, digitalizing customs and phytosanitary procedures) generally align with international recommendations for developing agricultural logistics in transition economies.

The human resources issue requires special attention, as it is frequently cited in the literature as a critical second-order factor (Cramer G.L., Clarence W.J.) [14]. The development of complex, technologically saturated logistical systems necessitates not only engineers and IT specialists to build them, but also a new generation of supply chain managers (SCM managers) within agricultural enterprises and logistics companies themselves. These specialists must possess competencies in strategic flow planning, digital platform operation, risk management, and sustainability (Abraliyev O.A., Sugirova G.S., Velesco S.) [15].

Conclusion

The analysis conducted allows for the following conclusions:

1. In the contemporary global economy, the efficiency of the agro-industrial complex is increasingly defined not by production volume alone, but by the sophistication of the logistical systems that deliver products to the final consumer.

For landlocked nations like Kazakhstan, the challenge of agricultural exports is compounded by vast territorial scales and the historical legacy of a transport model designed for bulk, non-perishable commodities. As the nation seeks to pivot toward a high-value-added export strategy, the traditional logistical framework has become a critical bottleneck that requires urgent systemic reconfiguration.

2. This study argues that the modernization of agricultural logistics must transcend simple infrastructure expansion. It demands a holistic integration of digital ecosystems, specialized human capital, and synchronized state policy. By examining the current "digital gaps" and the disconnect between diversifying production and outdated transport models, this research seeks to outline a path toward a resilient, technology-driven supply chain capable of sustaining Kazakhstan’s long-term agrarian development.

3. Logistical management is a critical factor for the further development and enhancement of the global competitiveness of Kazakhstan's agro-industrial complex, particularly in the context of its structural diversification.

4. Despite active state efforts to develop infrastructure and digitalization (the construction of hubs, the launch of digital platforms), key performance indicators for agricultural logistics -namely costs and losses -remain at an unsatisfactory level as of the end of 2024.

5. To achieve a qualitative breakthrough, it is necessary to consolidate fragmented measures into a comprehensive National Strategy for the Development of Agricultural Logistics. This strategy must synchronize infrastructure projects, digital solutions, state support measures, and human resource training.

6. A promising direction is to focus on creating end-to-end, high-tech supply chains for specific export-oriented product clusters (e.g., meat, fruit, and vegetables). This approach will enable the testing of operational models and the subsequent scaling of successful experiences.

7. Successful transformation relies on bridging "digital gaps" and human resource development, ensuring that infrastructure investments are supported by integrated information ecosystems and a new generation of SCM specialists capable of managing complex, technology-driven value chains.

8. Thus, the transformation of logistical management from a secondary support function into a vital development strategy for the agro-industrial complex is an urgent task. The realization of export potential and the sustainable growth of income in Kazakhstan's agricultural sector directly depend on its successful resolution.

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