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TOWARDS THE INNOVATIVE LOGISTICS MANAGEMENT SYSTEM IN THE AGRO-INDUSTRIAL COMPLEX OF THE REPUBLIC OF KAZAKHSTAN

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Abstract. This article investigates the impact of the structural transformation of agricultural enterprises on the development of an innovative logistics management system in the agro-industrial complex of the Republic of Kazakhstan. It explores the characteristics of the formation and evolution of agrarian relations, which serve as the main factors shaping the modern logistics management system in the agro-industrial complex. An analysis is conducted of indicators of structural transformation in the agricultural sector, including trends in the number of agricultural cooperatives, households, individual entrepreneurs, and peasant (farmer) farms, as well as the number of people employed in various forms of agricultural activity. The study examines the dynamics of organisational and legal forms of economic activity in the agricultural sector and the structure of employment among the rural population of the Republic of Kazakhstan by type of economic activity for the year 2025. Practical results of Kazakhstan's agrologistics development are presented. Based on the analysis, a model of an innovative logistics management chain in the agricultural sector of the Republic of Kazakhstan is proposed, taking into account the conditions of structural transformation of agricultural enterprises. A mechanism for developing an innovative logistics management system has been devised to increase the efficiency of agricultural production and integrate cooperative forms of economic activity into unified logistics chains. The results obtained can be used to formulate strategies for the sustainable development of the agricultural sector and to improve the management of logistics processes in the agro-industrial complex.

Keywords: logistics management; innovative system; agro-industrial complex; farms; cooperatives; agricultural companies; logistics centers

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1. Introduction

In recent years, the agro-industrial complex of the Republic of Kazakhstan has undergone a significant structural transformation, driven by changes in organisational and legal forms of business, the strengthening of cooperative processes, and the introduction of innovative approaches to the management of agricultural production. These changes are creating new operating conditions for agricultural enterprises and require a reevaluation of traditional approaches to organising logistics processes in the agricultural sector (Tleubayeva et al., 2023).

The structural transformation of agriculture is reflected in changes in the balance between various forms of agricultural production, including agricultural cooperatives, peasant (farmer) households, individual entrepreneurs, and private subsistence farms. These processes are accompanied by changes in the employment structure of the rural population, a redistribution of resources, and a strengthening of the role of small and medium-sized agribusinesses. Under these conditions, effective logistical coordination becomes increasingly important, ensuring the sustainability of production and distribution chains and enhancing the competitiveness of agricultural products (Nurzhanova et al., 2024).

Despite the active development of the agricultural sector, systemic problems persist, including insufficient integration among participants in logistics chains, limited digitalisation, and the fragmented nature of the agricultural market's infrastructure. These factors reduce the efficiency of interactions among producers, processors, and end consumers, calling for the creation of an innovative logistics management system adapted to the current conditions of the agribusiness sector's development (Kafi et al., 2025).

The relevance of this study stems from the need to scientifically substantiate the mechanisms underlying the development of logistics management in the context of the structural transformation of agricultural enterprises. Of particular importance is the development of a model for an innovative logistics management chain that ensures alignment of interests among participants in the agri-food market and enhances the efficient use of agriculture's resource potential.

The purpose of this study is to analyse the impact of structural transformation in agricultural enterprises on the development of an innovative logistics management system within the agro-industrial complex of the Republic of Kazakhstan and to develop an appropriate model to improve it.

2. Literature review and hypotheses' development

In the academic literature, issues related to the development of the agro-industrial complex and the improvement of logistics management are examined in the context of enhancing supply chain efficiency, promoting the sustainable development of rural areas, and implementing innovative management technologies. International studies emphasise the role of integrated logistics systems in ensuring food security and reducing transaction costs in the agricultural sector (Nurzhanova et al., 2023; Omarbakiyev et al., 2023). In particular, it is emphasised that the development of cooperative business models and the digitalisation of agri-food supply chains are key to enhancing agricultural competitiveness (Pashkevich, 2021).

Studies on logistics in the agricultural sector note a shift from linear supply chain management models to network- and platform-based models founded on the principles of flexibility, sustainability, and transparency (Nuansri et al., 2023). Particular attention is paid to the concept of "smart supply chains," which use digital technologies, big data, and monitoring systems to optimise the flow of products and resources (Wang et al., 2024).

Research on the agricultural economy of the Republic of Kazakhstan examines the processes of institutional transformation associated with the development of agricultural cooperatives, family farms, and individual entrepreneurship. Scholars note that the structural transformation of the agricultural sector has a significant impact on employment, the organisation of production, and the formation of new logistical links (Sahu et al., 2023). However, existing studies do not systematically link structural changes in agriculture to the development of innovative logistics systems (Oruç & Çağlar, 2022), thereby identifying a research gap for this study.

Thus, a review of the literature demonstrates the need for a comprehensive approach to studying the relationship between the structural transformation of agricultural enterprises and the development of innovative logistics management in the agro-industrial complex.

The main hypothesis of this study is that the structural transformation of agricultural enterprises in the Republic of Kazakhstan is the primary factor driving the formation and development of an innovative logistics

management system in the agro-industrial complex, thereby ensuring greater efficiency in agri-food supply chains.

Specific hypotheses of the study:

1. An increase in the share of cooperative and farm-based business models contributes to greater integration among participants in agricultural supply chains.
2. Changes in the employment structure of the rural population have a significant impact on the organisation and efficiency of logistics processes in the agricultural sector.
3. The development of innovative logistics infrastructure (digital platforms, coordination centres, information systems) enhances the resilience of agri-food supply chains.
4. The development of an innovative logistics management model helps reduce transaction costs and increase the competitiveness of agricultural products from the Republic of Kazakhstan (Nurzhanova, 2026).

3. Research objective and methodology

The purpose of this study is to analyse the impact of structural transformation in agricultural enterprises on the formation and development of an innovative logistics management system in the agro-industrial complex of the Republic of Kazakhstan, as well as to develop a model of an innovative logistics management chain and a mechanism for improving the efficiency of agricultural logistics processes in the context of institutional changes.

The methodological foundation of the study comprises general scientific and specialised methods of economic analysis, the systems approach, and logistics modelling, which enable the agro-industrial complex to be viewed as a multilevel, complex socioeconomic system.

The following methods were used in the course of the study:

System analysis - to examine the interrelationships between the structural transformation of agricultural enterprises and the development of logistics processes in the agro-industrial complex.

Comparative analysis - to assess trends in organisational and legal forms of business (cooperatives, farms, sole proprietorships, and household farms).

Statistical analysis - to process data on the number of agricultural enterprises and the employment structure of the rural population of the Republic of Kazakhstan for the year 2025.

Structural-functional approach - to identify the role of individual elements of the agricultural system in the formation of logistics chains.

Modelling - to develop a model of the innovative logistics management chain in the agro-industrial complex of the Republic of Kazakhstan amid structural transformation.

Induction and deduction - to generalise the obtained results and formulate theoretical conclusions.

The research's information base consisted of statistical data, analytical materials on the development of the agricultural sector in the Republic of Kazakhstan, and scientific publications by domestic and foreign authors on logistics management and agricultural economics.

The application of these methods made it possible to identify patterns in the transformation of agricultural enterprises and to substantiate directions for improving the innovative logistics management system in the agro-industrial complex.

4. Research results

Currently, research into the formation and development of agrarian relations, the causes of the crisis in agricultural production, and the innovation process in relation to logistics management, taking into account regional and sectoral characteristics, remains in high demand.

The continued development of private subsistence farms in Kazakhstan contributes to improved logistics management efficiency; however, ongoing integration processes in the agricultural sector should be taken into account (Akimbekova, 2023).

One must agree with the scholars' view that the restoration of economic relations during the transition to a market economy is linked to the formation of various types of organisational management structures and the transition of enterprises and organisations within the agro-industrial complex to full self-sufficiency and self-financing in regional agricultural enterprises (Belloc et al., 2024).

During the process of denationalisation and privatisation, cooperative ownership was drastically reduced. Accelerated reforms involving the forced bankruptcy of cooperatives and the creation of partnerships based on them did not increase the cooperatives' operational efficiency. Addressing this issue remains a priority, as cooperation is a necessary condition for the development of farms (peasant farms) in logistics management (Ofori et al., 2024).

An analysis of trends in the structural transformation of agricultural enterprises in the Republic of Kazakhstan (Table 1) reveals sustained structural transformation in the agricultural sector. According to statistics, between 2023 and 2025, the number of active agricultural cooperatives increased from 3,911 to 4,800, indicating an expansion of cooperative forms of economic activity.

At the same time, there has been an increase in the number of households, from 21,669 to 22,323; individual entrepreneurs and peasant (farmer) households, from 17,300 to 18,122; and legal entities, from 398 to 433. This trend reflects the diversification of the organisational and legal structure of agricultural production and the formation of a more complex system of interaction among agribusiness entities (Table 1).

Table 1. Indicators of structural transformation of agricultural enterprises in the Republic of Kazakhstan

Indicator	2023	2025 vs 2023 (Quantity)	2025
Number of active agricultural cooperatives, Republic of Kazakhstan	3 911	+889	4 800
Households	21 669	+654	22 323
Self-employed individuals and family farms	17 300	+822	18 122
Legal Entities	398	+35	433
Number of employees at the agricultural cooperative	7 490	+86	7 576
Number of employees of the agricultural cooperative who are employed on a part-time basis (by other organisations)	211	+296	507
Number of employees of an agricultural cooperative who perform work under civil law contracts (CLCs)	542	-44	498

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (n.d).
Statistics on Agriculture, Hunting, Forestry, and Fisheries for 2023-2025.

From the perspective of developing an innovative logistics management system in the agro-industrial complex, these changes have both positive and negative consequences. Among the positive aspects is the strengthening of cooperative processes in agriculture. The increase in the number of agricultural cooperatives contributes to consolidating resources and developing shared infrastructure for the storage, transportation, and processing of products. Cooperation allows small and medium-sized producers to pool their production volumes, reduce logistics costs, and improve the efficiency of using innovative digital supply chain management technologies (Croitoru et al., 2021). In addition, the consolidation of economic ties creates the conditions for implementing modern information systems for monitoring cargo flows, product traceability, and automating warehouse processes.

The growth in the number of smallholder (farmer) operations and individual entrepreneurs also indicates the development of entrepreneurial activity in the agricultural sector. This contributes to increased competition, stimulates the search for new logistics solutions, and creates demand for innovative services in transportation, storage, and the sale of agricultural products (Shen et al., 2023). Another positive factor is the increase in the number of employees at agricultural cooperatives, from 7,490 to 7,576. Expanding human resource capacity creates the conditions for adopting digital technologies, improving professional competencies in logistics management, and developing the human capital necessary to modernise the agro-industrial complex.

At the same time, this structural transformation is accompanied by some challenges. A significant increase in the number of small-scale agricultural producers leads to fragmented production and complicates the development of efficient logistics chains. The small production volumes of individual farms limit the ability to implement costly innovative technologies, automated warehouse complexes, and digital supply chain management platforms. As a result, transaction costs rise, and the efficiency of logistical coordination among market participants declines (Myssirov et al., 2023). An additional challenge is the lack of integration among producers, processing plants, and logistics operators. Despite the growing number of cooperatives, many entities continue to operate in isolation, hindering the creation of a unified logistics ecosystem and slowing the industry's digital transformation (Nursultanova 2026).

The change in the structure of employment deserves special attention. The number of workers employed under civil law contracts decreased from 542 to 498, suggesting a decline in the flexibility of labour resource utilisation. At the same time, the number of part-time workers increased significantly—from 211 to 507. This trend may indicate a shortage of skilled workers in agriculture and the need to improve the effectiveness of the training system for specialists in agricultural logistics and digital management.

Thus, the structural transformation of Kazakhstan's agricultural enterprises has a multifaceted impact on the development of an innovative logistics management system in the agri-food sector. On the one hand, the growth of cooperation, entrepreneurial activity, and human resource capacity creates conditions for the adoption of innovative logistics technologies. On the other hand, persistent fragmentation of production, insufficient integration among participants in agri-food supply chains, and human resource constraints hinder the formation of an effective innovative logistics system (Nurzhanova, 2026). In this regard, the further development of the agro-industrial complex should focus on strengthening cooperative ties, digitising logistics processes, and creating a unified infrastructure to manage agricultural supply chains.

The data in Table 2 indicate ongoing structural transformation in the agricultural sector of the Republic of Kazakhstan. Between 2021 and 2025, quantitative changes were observed in the composition of various categories of agricultural entities, reflecting the adaptation of agricultural production to modern economic conditions and the need to improve the efficiency of agri-food chain management.

Table 2. Trends in the Development of Organisational and Legal Forms of Business in Kazakhstan's Agricultural Sector

Years	Farm households	Households, in thousands	State-Owned Enterprises	Non-state-owned enterprises
2021	216 715	1416	35	5748
2022	224 231	1445	37	5701
2023	245 987	1512	35	5694
2024	276 411	1643	38	5689
2025	277 321	1509	39	5769
2025 compared to 2021, %	+27,97	+6,57	+11,43	+0,37

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (n.d). Statistics on Agriculture, Hunting, Forestry, and Fisheries for 2021-2025

As shown in Table 2, smallholder (farmer) farms experienced the most significant growth during the period under review, with the number increasing from 216,715 to 277,321, a 27.97% increase. This trend indicates the growing role of small and medium-sized agricultural enterprises in the country's economy. The expansion of

the farming sector contributes to greater flexibility in agricultural production, fosters a competitive environment, and stimulates the search for new organisational and economic solutions in logistics and product distribution.

The number of household farms increased from 1,416 to 1,509 thousand units during the period under review, representing a 6.57% increase. The growth of this indicator confirms that private subsistence farms continue to play a significant role in ensuring food security and forming the raw material base for the agro-industrial complex. However, the high share of small-scale commercial production simultaneously creates additional challenges for organising centralised logistics processes, including the collection, storage, transportation, and sale of agricultural products.

The number of state-owned enterprises increased from 35 to 39, a 11.43% increase. Despite their relatively small share in the overall structure of the agricultural sector, state-owned enterprises continue to perform important functions in ensuring the sustainability of specific areas of agricultural production, developing infrastructure, and implementing strategic programs to support the agro-industrial complex. The number of non-state-owned enterprises changed only slightly—from 5,748 to 5,769, representing an increase of just 0.37%. The virtually stable value of this indicator suggests that this market segment has reached a certain level of saturation and that the focus has shifted from quantitative growth to improving the efficiency of existing enterprises.

From the perspective of developing an innovative logistics management system, the identified changes are twofold. On the one hand, the increase in the number of farms contributes to the expansion of the agricultural sector's production base and the emergence of new commodity flows, creating conditions for implementing digital supply chain management platforms, product traceability technologies, and modern logistics services. On the other hand, the growth in the number of small-scale producers leads to the fragmentation of the agricultural market, complicates the coordination of logistics operations, and increases transaction costs at all stages of product movement from the producer to the end consumer.

Based on this analysis, the structural transformation of agricultural entities in the Republic of Kazakhstan is characterised by the strengthening of the farming sector and the continued significant role of household farms. Under these conditions, an important direction for the development of an innovative logistics management system is the integration of scattered producers into cooperative and digital logistics networks, which ensure greater efficiency in the functioning of the agro-industrial complex. The highest-priority type of small business in agriculture is smallholder (farmer) farms, the number of which is steadily increasing. It should be noted that the growth of smallholder (farmer) farms is contributing to a decline in the registered unemployment rate in rural areas (Roldan et al., 2023). Table 3 presents data on the employment of Kazakhstan's rural population by region, reflecting differences in the nature and form of employment.

Table 3. Employment of Kazakhstan's rural population by type of work for 2025, in persons

Region Name	Employment at the organisation	Sole proprietors	Employment on a Farm	In a personal home garden
Republic of Kazakhstan	1 703 624	771 116	218 386	322 853
Abai	60 053	43 832	2 238	11 060
Akmola	106 994	20 425	8 055	35 476
Aktobe	76 408	7 6138	8 155	16 014
Almaty	177 475	150 982	33 697	23 536
Atyrau	111 823	16 710	2 460	1 850
West Kazakhstan	61 608	31 153	8 317	25 455
Jambyl	134 903	91 374	24 060	31 275
Zhetisu	104 730	30 516	5 552	16 139
Karaganda	70 707	6 788	6 931	8 370
Kostanay	103 775	13 536	9 844	34 304

Kyzylorda	81 799	68 514	12 036	2 725
Mangystau	160 246	6 481	1 154	29
Pavlodar	57 110	5 919	9 793	30 395
North Kazakhstan	87 439	17 064	5 081	30 674
Turkestan	214 008	238 176	74 864	35 876
Ulytau	17 471	941	567	3 479
East Kazakhstan	77 075	21 067	5 582	16 196

Source: Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Industries (n.d)

As shown in Table 3, the Almaty Region has a significant number of salaried employees in organisations, as does the Turkestan Region. The Turkestan Region has 238,176 self-employed individuals, which is more than double the number of wage earners. This may be due to both strong entrepreneurial activity and a shortage of permanent jobs. The situation in the Almaty Region is similar, suggesting a high level of self-employment. In the Atyrau and Mangystau regions, employment in farms and private subsistence farms is extremely low. This is due to the specific nature of the region's economy, which is dominated by the oil and gas industry—an industry that does not require many agricultural workers. In the North Kazakhstan and Kostanay regions, a significant number of people are employed in private subsistence farms—30,674 and 34,304, respectively. This may indicate insufficient agricultural production and limited opportunities for farm development, which calls for more effective support programs for small farms. In the Karaganda and Pavlodar regions, the number of individual entrepreneurs is only 6,788 and 5,919, respectively, which may indicate a lack of entrepreneurial initiative and a higher level of dependence on traditional forms of employment. In the Turkestan region, the high proportion of sole proprietors may indicate growth in small businesses, self-employment, and entrepreneurial initiatives, which are an important component of the region's logistics sector activity. In the Akmola region, 8,055 people are employed on farms, indicating moderate growth in this sector. In the Turkestan Region, the number of such workers is significantly higher—74,864 people. This may suggest that farms play a major role in the region's logistics, possibly due to favourable agricultural conditions. As a result, the Turkestan region significantly outpaces the Akmola region in the number of sole proprietors and farm workers, indicating greater activity in small business and farming. The Akmola Region, in turn, shows more moderate figures in these areas, while maintaining a significant share of workers in organisations and private subsistence farms.

This comparative study reveals that a more diversified and dynamic economy characterises the Turkestan region. In contrast, the Akmola region is more dependent on traditional forms of employment, such as salaried work in organisations and subsistence farming. It should be noted that the structural transformation of agricultural enterprises in the Republic of Kazakhstan is accompanied not only by an increase in the number of farms and cooperatives, but also by the formation of large, integrated agro-industrial structures capable of implementing modern technologies in production, processing, and logistics. Such enterprises serve as key drivers of the development of an innovative logistics management system, as they facilitate the concentration of material flows, the development of logistics infrastructure, and the implementation of digital solutions in supply chains.

A prime example is the “Rodina” agricultural firm, which operates as a limited liability partnership. The farm encompasses three settlements—Rodina, Zeleny Gai, and Sadovoye—and employs more than 520 people out of a total population of approximately 1,800. Annual production volume amounts to approximately 5.2 billion tenge, with livestock products accounting for about 50% of that total. As part of the modernisation of its production activities, the enterprise is actively investing in the development of its material and technical base, including the acquisition of high-tech agricultural machinery and vehicles, the construction of a grain terminal with a capacity of 20,000 metric tons, the establishment of its own dairy processing plant, and the implementation of energy infrastructure projects (Saparova & Sultanova 2020). From the perspective of logistics management development, having one's own warehousing and transportation infrastructure, processing facilities, and the integration of various stages of the agri-food chain within a single economic system are of

particular importance. Such vertical integration enables the optimisation of storage, transportation, and distribution processes, reduces logistics costs, and improves the efficiency of material flow management.

Similar processes are observed in the operations of Zenchenko & Company LLP and in large processing enterprises in the dairy, fruit and vegetable, and meat industries. The development of these enterprises demonstrates a transition from traditional forms of agricultural production to more complex, integrated organisational and economic structures, in which logistics has become a key factor in competitiveness. The successful experience of Kazakhstan's leading agro-industrial enterprises confirms that the structural transformation of agricultural enterprises contributes to the formation of a modern, innovative logistics management system through the development of production and logistics infrastructure, the introduction of technological innovations, the integration of supply chain participants, and the improvement of material flow management efficiency.

Practical results of the development of agrologistics in Kazakhstan

Over the past few years, Kazakhstan's agro-industrial sector has demonstrated steady growth in its export potential, accompanied by increasing demand for more efficient logistics infrastructure. Modern agrologistics encompasses not only the transportation of agricultural products but also the management of storage, shipment consolidation, quality control, digital support of supply chains, and the development of export channels.

At present, the total grain storage capacity in Kazakhstan amounts to 15.8 million tonnes, including grain elevators and grain receiving facilities. At the same time, projects are being implemented to construct new grain storage facilities and modernise the existing storage infrastructure. These initiatives aim to reduce logistics losses, improve the preservation of agricultural products, and enhance the efficiency of commodity flow management. Despite the substantial grain storage capacity, the development of Kazakhstan's logistics infrastructure remains uneven. The most advanced logistics capabilities are concentrated within large agricultural holdings, which operate their own grain elevators, transport fleets, and processing facilities. At the same time, small agricultural producers often face limited access to modern storage facilities and encounter difficulties in consolidating export shipments and organising efficient product distribution. Under these conditions, the development of agricultural cooperatives, the establishment of distribution centres, and the implementation of digital logistics management technologies become increasingly important. One of the most prominent examples of the development of Kazakhstan's modern agrologistics system is the activity of JSC National Company "Food Contract Corporation". The company plays a key role in coordinating grain flows, managing the state grain reserves, and organising export deliveries. Acting as an integrator of the logistics system, the corporation facilitates cooperation among agricultural producers, grain elevator facilities, transport operators, and international buyers, thereby ensuring the efficient operation of the entire supply chain. During the first half of 2026, the national operator provided KZT 51.6 billion in financing to agricultural producers. Following the fulfilment of forward contracts and the completion of final settlements for delivered agricultural products, the total amount of financial support for farmers is expected to reach KZT 65.7 billion.

Under the direct agricultural procurement program, farmers supplied 191.8 thousand tonnes of grain and oilseed crops to the Food Contract Corporation, more than three times the previous year's volume (52.9 thousand tonnes). The largest share of deliveries came from producers located in Kazakhstan's major grain-producing regions. In total, the national operator received applications from 257 agricultural producers for the supply of wheat, barley, sunflower, and oil flax. Under the signed direct procurement contracts, the national grain operator transferred 20.3 billion tenge to farmers. A total of 172 agricultural enterprises participated in the forward financing program for the 2026 spring field campaign by signing contracts to supply 471 thousand tonnes of grain and oilseed crops. Farms in the Akmola, North Kazakhstan, and Kostanay regions are committed to supplying mainly third-class wheat.

In contrast, producers in the Pavlodar and East Kazakhstan regions focus primarily on sunflower deliveries. In the spring of 2026, the national operator allocated 31.3 billion tenge in advance financing to agricultural producers. Following the harvest and the completion of final settlements, the total financing provided under the program is expected to exceed 40 billion tenge. At the same time, the forward financing program encourages

the expansion of high-value oilseed crop production. While forward contracts for the supply of sunflower, oil flax, and rapeseed totalled 36 thousand tonnes in 2025, this figure nearly tripled to 94.9 thousand tonnes in 2026. Under the terms of the signed contracts, agricultural producers plan to deliver 37.8 thousand tonnes of sunflower seeds, 51.5 thousand tonnes of oil flax seeds, and 5.6 thousand tonnes of rapeseed after the harvest (Corporate News 2026). Thus, the mechanisms of direct procurement and forward financing perform several strategic functions simultaneously. They provide agricultural producers with essential financial resources while contributing to the formation of the country's strategic food reserves. Through the annual procurement of agricultural products, the Food Contract Corporation replenishes the state grain reserves, establishes feed grain stocks for the livestock and poultry sectors, and maintains grain reserves for flour milling and other processing industries.

Another example of the implementation of modern logistics solutions is the modernisation of grain storage facilities operated by the Food Contract Corporation. In 2024, the volume of grain received at the corporation's grain storage facilities reached 411.7 thousand tonnes, nearly doubling the level recorded in the previous year. During the same period, grain shipments increased to 346.4 thousand tonnes, representing almost 18% **growth**, while the maximum simultaneous storage capacity reached 288.6 thousand tonnes. These indicators demonstrate improvements in the efficiency of the country's storage and logistics infrastructure. At the same time, modern digital technologies for logistics management are being introduced at the corporation's storage facilities. These include automated grain temperature-monitoring systems, video surveillance, digital quality-control tools, and automated warehouse-management technologies. The implementation of these solutions helps minimise storage losses, accelerate cargo handling, and improve the transparency and efficiency of material flow management throughout the logistics chain.

The obtained results indicate a gradual transformation of Kazakhstan's agrologistics, with traditional approaches to agricultural product storage being progressively replaced by digital supply chain management systems. This transformation is based on continuous monitoring of product quality, the automation of logistics processes, and the integration of information technologies into warehouse operations, thereby improving the efficiency of material flow management throughout the supply chain (Table 4).

Table 4. Practical results of agrologistics development in Kazakhstan for 2024–2025

Indicator	Food Contract Corporation	Grain storage facilities
Grain sales	1.3 million tonnes	411.7 thousand tonnes received
Export destinations	12 countries	Regional logistics
Storage	State grain reserve	288.6 thousand tonnes
Logistics innovations	Consolidation of export consignments	Digital temperature monitoring, warehouse automation
Practical impact	Growth in exports and supply chain resilience	Reduced storage losses and improved storage efficiency

Source: Compiled by the author based on data from the Ministry of Agriculture of the Republic of Kazakhstan and JSC National Company "Food Contract Corporation" (n.d)

The results indicate a gradual transition in Kazakhstan's agrologistics from a traditional transportation and storage model to integrated supply chain management. Further improvements in the sector's efficiency are associated with the development of digital technologies, the modernisation of storage infrastructure, and the expansion of export transportation routes. An important priority is to strengthen cooperation among agricultural producers, logistics operators, and government institutions to enhance the resilience of the country's agri-food system. Furthermore, the wider adoption of advanced information technologies and intelligent management systems will improve the transparency of logistics processes, reduce operational costs, and strengthen the competitiveness of Kazakhstan's agricultural products in international markets. Taken together, these measures provide a solid foundation for developing a modern, resilient, and efficient agrologistics system that meets the requirements of international trade and supports the long-term development of the country's agro-industrial sector.

5. Model of the innovative logistics management chain in the agro-industrial complex of the Republic of Kazakhstan

The analysis conducted has shown that the structural transformation of agricultural enterprises in the Republic of Kazakhstan is accompanied not only by changes in organisational and legal forms of business and an increase in entrepreneurial activity in the agricultural sector, but also by a significant transformation of logistics processes. In this regard, there is a need to create a unified, integrated logistics system that ensures effective interaction among all participants in the agricultural value chain—from resource suppliers to the end consumer. Taking into account the identified trends in the structural transformation of agricultural enterprises and modern requirements for the organisation of logistics processes, we propose a model of an innovative logistics management chain for the agro-industrial complex of the Republic of Kazakhstan, as shown in Figure 1.

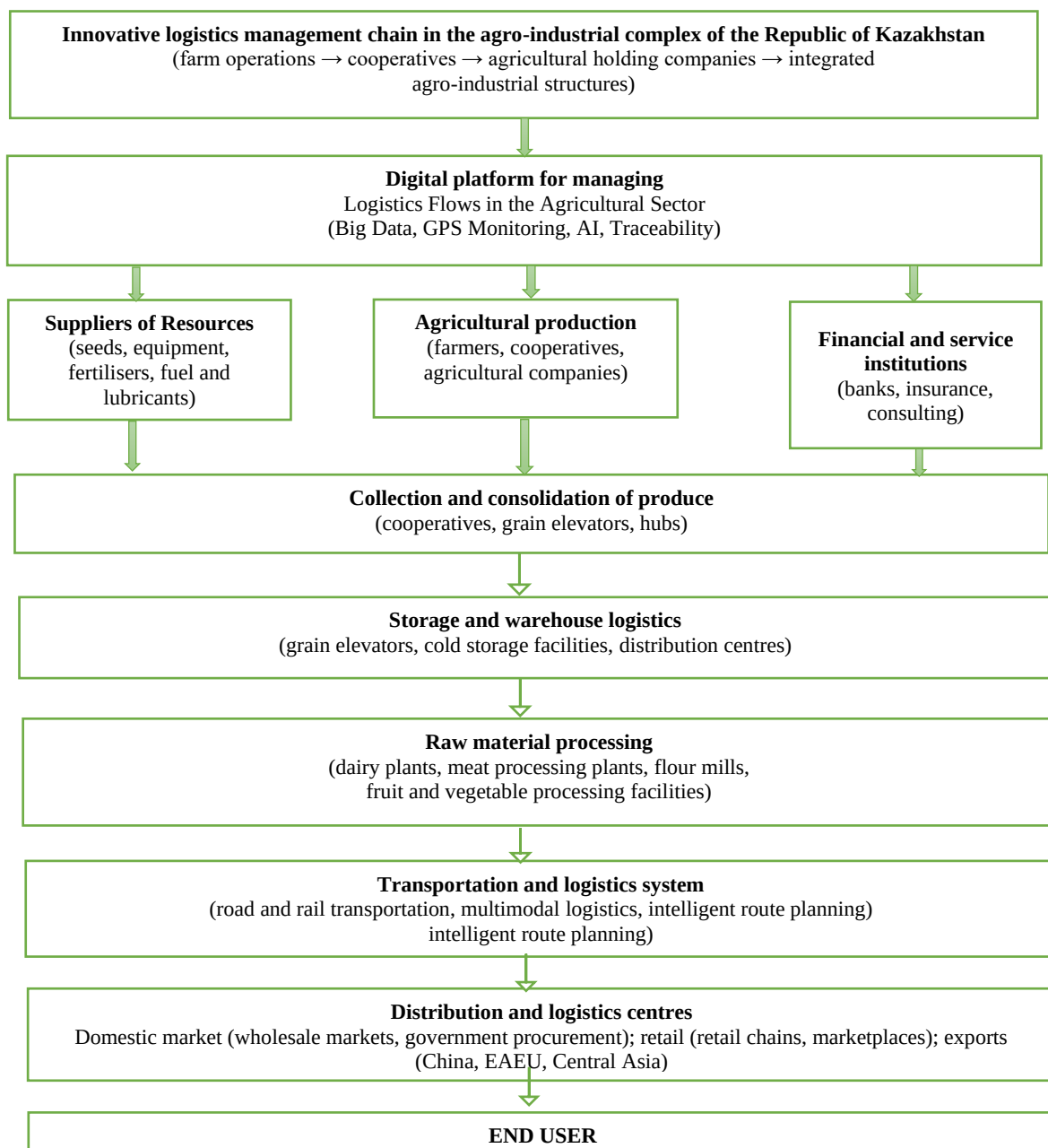


Figure 1. Model of the innovative logistics management chain in the agro-industrial complex of the Republic of Kazakhstan
Source: Prepared by the authors

The logistics management chain presented here reflects the modern model for organising material, information, and financial flows in the agro-industrial complex of the Republic of Kazakhstan amid the structural transformation of agricultural enterprises. This model is based on changes in the organisational and economic structure of the agricultural sector, as evidenced by the development of family farms, agricultural cooperatives, agribusinesses, and vertically integrated agro-industrial entities.

The structural transformation of agricultural enterprises directly affects the organisation of logistics processes, as changes in production scale, specialisation, and cooperation among economic actors require the development of new mechanisms for managing material flows. In this context, a digital platform for managing logistics processes is playing a key role, ensuring the integration of all participants in the agri-food chain through modern information and communication technologies. The use of Big Data, GPS monitoring, product traceability systems, and artificial intelligence helps increase supply chain transparency and the speed of management decision-making (Mardenli et al., 2025).

The initial link in the logistics system comprises suppliers of material and technical resources who provide agricultural producers with seeds, fertilisers, plant protection products, agricultural machinery, and fuels and lubricants. Next, production flows are formed at the level of farms, cooperatives, and agro-industrial enterprises, where agricultural raw materials and products are produced.

The next stage involves consolidating commodity flows through agricultural cooperatives, grain elevators, and logistics hubs. The concentration of production helps overcome the problem of production fragmentation characteristic of Kazakhstan's modern agricultural sector and also contributes to reducing transportation and transaction costs. After consolidation, the products enter a storage system comprising grain elevators, cold storage facilities, distribution centres, and modern warehouses. The development of warehouse infrastructure ensures that product quality is maintained and losses during storage are minimised.

The processing of agricultural raw materials is a key element of the logistics chain. The development of modern processing complexes enables increased product added value, expanded product range, and improved efficiency in the utilisation of agricultural raw materials. As integrated agro-industrial structures develop, the processes of production, storage, processing, and sales are increasingly consolidated within a single logistics system (Kyfyak et al., 2023).

The transportation and logistics subsystem ensures the movement of goods between all links in the supply chain. The use of modern vehicles, digital technologies for monitoring shipments, and intelligent route-planning systems helps reduce delivery times, lower logistics costs, and improve delivery reliability. Of particular importance to Kazakhstan is the development of multimodal transportation, which ensures effective integration of road, rail, and international transport networks.

In the final stage, the products are delivered to distribution and logistics centres, from where they are shipped to the domestic market, retail chains, or export markets. The development of export-oriented logistics is becoming a key factor in enhancing the competitiveness of the domestic agro-industrial complex and expanding the presence of Kazakhstani products in foreign markets. The operation of an innovative logistics management system delivers comprehensive economic benefits, including reduced logistics costs at all stages of product distribution, reduced losses of agricultural raw materials and finished products, and improved efficiency in managing inventory and transportation flows (Amamou 2025).

As a result, the competitiveness of agribusiness enterprises increases, the industry's export potential expands, the country's food security is strengthened, and conditions are created for achieving sustainable development goals. The structural transformation of agricultural enterprises is not only a consequence of the modernisation of the agricultural sector but also a key factor in the formation of an innovative logistics management system in the agro-industrial complex of the Republic of Kazakhstan.

6. The mechanism for developing an innovative logistics management system in the agricultural sector of the Republic of Kazakhstan

Based on the model's results, we propose a mechanism to develop an innovative logistics management system for the agricultural sector of the Republic of Kazakhstan (Table 5). The proposed mechanism is based on the comprehensive use of organisational, infrastructural, digital, and innovative tools that create a synergistic effect in managing agricultural supply chains.

Table 5. Mechanism for developing an innovative logistics management system in the agricultural sector of the Republic of Kazakhstan

Development of the innovative logistics management system in the agro-industrial complex
An increase in the number of farms; an increase in the number of agricultural cooperatives; the growth of entrepreneurial activity; changes in the structure of employment
Problems
<i>Fragmentation of production:</i> High transportation costs; insufficient integration among market participants; low level of digitisation in logistics processes; product losses during storage and transportation
Development tools
➤ <i>Organisational:</i> development of agricultural cooperatives; creation of logistics clusters; integration of producers, processors, and trading organisations. ➤ <i>Infrastructure:</i> construction of distribution centres; development of warehouse infrastructure; modernisation of transportation and logistics hubs. ➤ <i>Digital:</i> digital supply chain management platforms; GPS tracking of shipments; big data technologies; product traceability systems. ➤ <i>Innovative:</i> warehouse automation; intelligent route planning; use of artificial intelligence technologies; implementation of «smart logistics».
An innovative logistics management system
<i>Coordination of material flows:</i> Supply optimisation; Inventory Management; Transportation Management; Digital Monitoring of Supply Chains
Results
<i>Reducing logistics costs:</i> Reducing agricultural product losses; increasing the competitiveness of agribusiness enterprises; boosting export potential; strengthening food security; achieving sustainable development goals

Source: Prepared by the authors

The organisational component of the mechanism calls for the development of agricultural cooperation, the formation of logistics clusters, and the strengthening of integrative ties between producers, processing enterprises, and trading organisations. The implementation of these measures contributes to the consolidation of commodity flows, a reduction in transaction costs, and improved coordination among market participants. The infrastructure component focuses on creating modern distribution centres, developing warehouse infrastructure, and modernising transportation and logistics hubs. This will reduce the time and financial costs of product delivery, improve the quality of storage of agricultural raw materials, and minimise product losses throughout the supply chain.

The proposed mechanism places particular emphasis on the digital transformation of logistics processes. The implementation of digital supply chain management platforms, GPS-based transportation monitoring technologies, big data analytics, and product traceability systems ensures supply chain transparency, enables prompt management decision-making, and improves the efficiency of logistics resource utilisation. The innovative component of the mechanism includes the automation of warehouse operations, intelligent route planning, the use of artificial intelligence technologies, and the implementation of the "smart logistics" concept. The implementation of these solutions helps optimise material flows, reduce order processing times, improve demand forecasting accuracy, and enhance the quality of logistics services.

A key component of the mechanism is an innovative logistics management system that coordinates the flow of goods at every stage of the product's journey from the manufacturer to the end consumer. The system is designed to optimise deliveries, manage inventory efficiently, organise transportation effectively, and monitor supply chains digitally. The proposed mechanism will make it possible to achieve significant socioeconomic results, including a reduction in logistics costs, a decrease in agricultural product losses, an increase in the competitiveness of agribusiness enterprises, an expansion of export opportunities for domestic producers, a strengthening of the country's food security, and the implementation of the principles of sustainable development. Thus, the need to implement an innovative logistics management system stems from the objective processes of structural transformation in the agricultural sector and the need to improve the efficiency of the logistics infrastructure of the Republic of Kazakhstan's agro-industrial complex.

Conclusions

This study has demonstrated the key role of structural transformation in agricultural enterprises in the formation and development of an innovative logistics management system within the agro-industrial complex of the Republic of Kazakhstan.

It has been established that changes in the organisational and legal structure of the agricultural sector, associated with the growing share of cooperatives, family farms, and individual entrepreneurship, create new conditions for integrating participants in agri-food supply chains and improving the efficiency of logistics processes.

An analysis of statistical data has shown that structural changes in the agro-industrial complex are accompanied by a transformation in rural employment and a redistribution of labour resources among various forms of economic activity. This, in turn, reinforces the need to develop a flexible and adaptive logistics management system focused on cooperation, digitalisation, and reducing transaction costs.

1. This study proposes a model of an innovative logistics management chain for the agricultural sector of the Republic of Kazakhstan, taking into account the specific nature of the structural transformation of agricultural enterprises. This model ensures systematic interaction among agricultural market participants—including producers, processors, logistics centres, and end consumers—based on the principles of integration and digital coordination.
2. The mechanism developed for advancing an innovative logistics management system makes it possible to enhance the resilience of agri-food supply chains, improve the manageability of resource and product flows, and boost the competitiveness of the country's agricultural sector.
3. The results of the study confirm the hypotheses put forward and demonstrate that the structural transformation of agricultural enterprises is one of the key factors in improving the efficiency and innovation of logistics management in the agro-industrial complex of the Republic of Kazakhstan.

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