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## **Influence of logistics systems on the development of international trade in the agricultural sector of Kyrgyzstan**

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**Abstract.** The purpose of this study was to analyse the role of logistics systems in ensuring the efficiency of foreign trade in Kyrgyzstan's agricultural products. To fulfil this purpose, the study investigated the dynamics of Kyrgyzstan's foreign trade in agricultural products in 2020-2024, with a focus on export and import growth, as well as investments in logistics infrastructure. The methodology included a comprehensive approach combining economic and statistical, correlation, factor analysis, and modelling of development scenarios to assess the influence of logistics on Kyrgyzstan's

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international trade in the agricultural sector. The study found that Kyrgyzstan is showing a steady increase in foreign trade in agricultural products, with exports growing from USD 2.5 billion in 2020 to USD 3.5 billion in 2024, indicating an improvement in the competitiveness of products in international markets. Modernisation of the transport and logistics infrastructure has helped to reduce transportation costs and improve storage conditions, which has positively affected the exports of key agro-export commodities such as dried fruits, cotton, and dairy products. The results of the correlation analysis, where the correlation coefficient ( $R$ ) is 0.9226, confirmed the existence of a strong positive relationship between the volume of investment in logistics infrastructure and the foreign trade turnover of the Kyrgyz agriculture sector. However, the country faces serious challenges, such as bureaucratic barriers and an unstable economic situation, which limit its integration into global supply chains. To address these challenges, reforms in customs procedures, investments in road infrastructure, and the creation of modern logistics hubs are needed to increase the competitiveness of agricultural products on international markets.

**Keywords:** exports; imports; trading partners; investments; infrastructure

## INTRODUCTION

In modern globalised economy, the development of international trade in the agricultural sector is becoming increasingly significant. This sector is key to ensuring food security, creating jobs, and boosting economic growth in many countries. However, the efficiency of international trade largely depends on the functioning of logistics systems, which are the basis for ensuring stable supplies, reducing costs, and increasing the competitiveness of products on global markets. Logistics systems in the agricultural sector play a critical role in the transport, storage, and distribution of agricultural products. Their development helps to optimise value chains, reduce product losses, promote the introduction of modern technologies, and create new export opportunities. At the same time, the integration of logistics solutions with digital technologies and sustainable approaches is becoming a crucial factor in achieving international quality and environmental safety standards (Yahelyuk et al., 2023).

Effective development of the agricultural sector depends not only on the level of production technology, but also on the ability to ensure fast, reliable, and cost-effective movement of products to internal and international markets. For Kyrgyzstan, an agriculturally orientated country, international trade in agricultural commodities is a key component of its economic stability and integration into the global economy. However, the limited development of logistics systems, high transportation costs, and the country's geographical location (landlocked) pose substantial obstacles to the realisation of the agricultural sector's potential (Kozhogulova et al., 2023). Studies of the influence of logistics systems on the development of the agricultural sector cover a variety of aspects, ranging from the introduction of digital technologies to the optimisation of transport routes. For example, digitalisation of logistics processes plays a key role in improving the efficiency of product transportation (Aubakirova, 2024). According to Y. Lopatynskiy et al. (2023) and B. Matkovski et al. (2022), digital technologies can reduce the time of delivery of goods, minimise costs, and ensure the

competitiveness of agricultural companies in international markets. D. Şahan and O. Tuna (2021) believes that modern technologies not only increase the efficiency of companies but also ensure their adaptation to global market conditions. Y. Zhao et al. (2023) and A. Mishrif et al. (2024) emphasise that the integration of information and communication technologies creates transparent supply chains, allowing for more effective control over the movement of goods, which is especially relevant for countries with geographical restrictions.

A significant factor is the development of transport infrastructure, which helps to reduce logistics costs and increase the competitiveness of products (Artyukh et al., 2023). Investments in roads, railways, and ports create conditions for faster delivery of goods and better service for international deliveries. S. Vinoth et al. (2022) argued that the combination of digitalisation and infrastructure modernisation ensures the efficiency of logistics processes in the agricultural sector. Logistics corridors play a significant role in the context of international trade. According to X. Lu et al. (2024), these corridors are particularly significant for countries without direct access to the sea, as they facilitate integration into global markets, stimulate regional development, and support economic growth.

At the same time, high logistics costs continue to be a fundamental problem for Central Asian countries. H. Brauweiler et al. (2023) noted that optimisation of transport routes is a key tool for reducing production costs, which increases the competitiveness of agricultural exports. Furthermore, according to A.M. Olyan-ga et al. (2022), solving this problem requires coordination between the government, the private sector, and international organisations. Coordinated actions in the development of logistics infrastructure create the pre-conditions for integration into global supply chains. In this context, the development of regional transport and logistics hubs deserves special attention, which is critical for Central Asian countries. According to N. Parpieva et al. (2023), the effective functioning of such hubs, particularly in Kyrgyzstan, helps to expand the export

opportunities of the agricultural sector. This increases the sustainability of products on international markets and ensures their compliance with modern global trade requirements.

Despite a considerable body of research, many aspects related to the specific conditions of Central Asian countries, including Kyrgyzstan, are still unexplored. The key problems continue to be the country's insufficient integration into global supply chains due to weak transport infrastructure and low level of digitalisation of logistics. The purpose of this study was to determine the influence of logistics systems on the development of international trade in Kyrgyzstan's agricultural products, identify the key barriers to logistics processes, and develop recommendations for improving the logistics infrastructure for integration into global supply chains.

## MATERIALS AND METHODS

The study to assess the influence of logistics on the development of international trade in the agro-industrial sector of the Kyrgyz Republic for 2020-2024 was based on the analysis of statistical data on exports and imports of agricultural products, specifically grains, vegetables, and fruits, as well as information on the country's logistics infrastructure. The key sources were the National Statistical Committee of the Kyrgyz Republic (n.d.), which provided data on foreign trade volumes and the structure of trade partners in the agricultural sector, and the Ministry of Economy and Commerce of the Kyrgyz Republic (n.d.), which provided information on investments in the transport and logistics sector:

1. Assessment of foreign trade. To analyse the structure of foreign trade, the study used the statistical data on export and import operations. The dynamics of trade in the agricultural sector, specifically, the volume of exports and imports of agricultural products, was investigated, and the key trading partners were identified. The analysis of changes in foreign trade flows, based on average annual growth rates and other indicators, helped to assess the development trends and stability of trade for 2020-2024.

2. Determination of the total volume of investments in logistics infrastructure. The volume of financial investments in the development and modernisation of the logistics infrastructure of Kyrgyzstan was estimated, specifically, the study explored the sources of investments, both internal (government and private) and external (international financial organisations and investors). The study analysed structural changes in the areas of investment that contributed to the development of critical elements of transport and logistics infrastructure.

3. Study of logistics infrastructure. The study assessed the state of the country's existing transport and logistics network, including road and rail connections, as well as key international transport corridors. The study identified the infrastructure nodes through which most foreign trade operations are carried out. Special

attention was paid to the examination of the functioning of trade and logistics centres and their potential in the context of future economic development.

4. Modelling of interrelations. The study employed mathematical modelling to assess the influence of logistics infrastructure development on foreign trade turnover. Using the method of correlation analysis, the relationship between investments in logistics infrastructure and the growth of trade turnover in the agricultural sector is determined. Based on the obtained results, the study offered forecasts to assess the effects of changes in infrastructure on international trade until 2028.

The study employed a comprehensive approach that included a variety of methods to comprehensively analyse the influence of logistics on Kyrgyzstan's foreign trade. The economic and statistical analysis helped to investigate statistical data and identify the principal trends in foreign trade, specifically by calculating the average annual growth rate, which helped to assess the dynamics of trade operations and their structure in terms of exports and imports. The analysis examined the foreign trade turnover, the ratio between export and import operations, and the geographical structure of trade with major partners. The forecasting method, namely the time series method, was employed to predict changes in foreign trade volumes and investments in logistics infrastructure until 2028. Possible economic scenarios were also assessed, considering the trends that emerged over 2020-2024, which helped to predict the potential influence of infrastructure projects on foreign trade.

Correlation and factor analysis were used to determine the relationship between infrastructure development and the dynamics of international trade in the agricultural sector, which helped to assess the extent to which investments in transport infrastructure affect foreign trade. Factor analysis also helped to identify the key factors affecting trade turnover in the agricultural sector and to identify prospects for improving infrastructure conditions. The method of modelling development scenarios was employed to assess possible options for the development of logistics infrastructure and its effects on international trade, which helped to predict the most effective strategies for the development of transport and logistics routes in the country. These methods enabled a comprehensive analysis of the situation in the field of logistics and international trade in Kyrgyzstan, identifying the key problems and opportunities for improving infrastructure and increasing the country's economic potential for integration into global supply chains.

## RESULTS

According to the National Statistical Committee of the Kyrgyz Republic (n.d.), there has been a steady increase in foreign trade in agricultural products in 2020-2024. Exports and imports are gradually increasing, reflecting

a positive trend in the development of the agricultural sector and its integration into international markets. Specifically, exports increased from USD 2.5 billion in 2020 to USD 3.5 billion in 2024, which is a positive signal for the Kyrgyz economy. On average, export growth is about 8% annually, which demonstrates the improved competitiveness of agricultural products in international markets. The highest annual export growth rate (10%) was recorded in 2023, which may be the result of improved product quality and increased demand for agricultural products from foreign markets.

Imports also tend to grow, but the rate of growth is less stable. Imports increased from USD 3.2 billion

in 2020 to USD 4 billion in 2024. The growth rate of imports was higher in the first years (6-8%), but since 2024, there has been a significant slowdown in import growth to 3%, indicating a certain stabilisation of foreign trade and a gradual reduction in dependence on imported goods. The foreign trade turnover is generally growing, from USD 5.7 billion in 2020 to USD 7.5 billion in 2024, reflecting positive trends in the development of trade and Kyrgyzstan's integration into the global economy. In 2023, the largest increase in foreign trade turnover (about 15%) is observed, which indicates the intensification of trade operations, especially in the agricultural sector (Table 1)

**Table 1.** Trade dynamics in the agricultural sector of Kyrgyzstan (2020-2024)

Year	Exports (million USD)	Imports (million USD)	Foreign trade turnover (USD million)	Export growth rate (%)	Import growth rate (%)
2020	2,500	3,200	5,700	-	-
2021	2,700	3,400	6,100	8%	6%
2022	2,900	3,600	6,500	7%	6%
2023	3,200	3,900	7,100	10%	8%
2024	3,500	4,000	7,500	9%	3%

**Source:** compiled by the authors

Overall, the analysis of Kyrgyzstan's exports and imports suggests a certain balance between the growth of both components, although dependence on imports continues to be high. That is why this situation requires further efforts to develop internal production and exports, specifically to reduce the trade deficit and improve competitiveness in the global context. Kyrgyzstan's trade relations show a diversity of partners and reflect significant trends in the country's economic ties. For instance, Kazakhstan and Turkey are the 3<sup>rd</sup> and 4<sup>th</sup> largest trading partners, respectively, with shares of 6.5% and 4.5%. Both countries have extensive exports

to Kyrgyzstan, and Kazakhstan, specifically, is a major transit partner. Imports of goods from Turkey are also an essential aspect of trade relations, highlighting the diversity of domestic goods supplied from this country. South Korea, albeit with a smaller share of trade, is an active supplier of high-quality technology goods. European countries, including France and Germany, are also significant partners, although their share of Kyrgyzstan's trade is smaller. Afghanistan and Turkmenistan, despite their geographical and political proximity, have significant export positions, suggesting that there are considerable trade flows in this area (Table 2).

**Table 2.** Kyrgyzstan's trade partners, including trade volume (USD billion)

Country	Trade volume (billion USD)	Share in total trade volume (%)	Exports (USD million)	Imports (USD million)
China	2.1	18.9	2,054.9	10,431.8
Kazakhstan	0.7	6.5	1,452.3	2,825.5
Turkey	0.5	4.5	1,169.3	1,768.0
South Korea	0.3	3.0	39.9	1,960.8
India	1.0	1.5	126.8	853.6
France	1.1	1.7	795.1	336.2
Afghanistan	1.1	1.7	1,089.3	44.9
Turkmenistan	1.1	1.7	128.2	1,020.0
Germany	1.2	1.8	97.5	1,116.5
Italy	0.7	0.9	63.4	621.7

**Source:** compiled by the authors

The study found that Kyrgyzstan has a well-developed transport infrastructure, although some regions have considerable limitations due to mountainous terrain. The country has an active road network that provides transport links both internally and with

neighbouring countries, including Kazakhstan, Uzbekistan, and Tajikistan. Road transport is the principal means of transporting goods and passengers due to complicated natural conditions and the lack of a complete railway infrastructure in certain areas. Rail

connectivity in Kyrgyzstan is limited by the number of railway lines connecting the country with neighbouring countries, but its role in the overall transport network is significant, especially for freight transport. Prospects for the development of this component of the infrastructure include the expansion of railway routes, improved connections with Central Asian countries and international markets, which will increase the efficiency of transporting goods.

Kyrgyzstan is a valuable transit hub between Central Asia and other regions of the world. The international transport corridors that pass through the country are of strategic significance to the economy. For example, the China-Kyrgyzstan-Uzbekistan corridor is significant for the development of trade between

China and Central Asian countries. The development of such corridors will help increase the flow of goods, improve economic ties, and reduce transport costs. Furthermore, Kyrgyzstan is taking an active part in the development of international transport initiatives, such as programmes to integrate transport infrastructure within the Silk Road, which has significant potential for economic growth (Table 3). The prospects for the development of Kyrgyzstan's transport and logistics infrastructure require a comprehensive approach, including road modernisation, expansion of the railway network, and active development of international transport corridors. This will not only improve internal transport links but also increase the country's transit capacity.

**Table 3.** Analysis of the components of the transport and logistics infrastructure of Kyrgyzstan and development prospects

Infrastructure component	Description	Development prospects
Motorways	Significant roads connecting Kyrgyzstan with neighbouring countries (Kazakhstan, Uzbekistan, Tajikistan).	Modernisation and construction of new roads to improve accessibility and efficiency of transportation.
Railway connection	Limited railway network, particularly between Kyrgyzstan and its neighbours.	Improvement of railway lines to increase freight efficiency and reduce logistics costs.
International transport corridors	Significant corridors, particularly through China, Uzbekistan, and Kazakhstan.	Development of new international corridors and integration with international transport networks.
Trade and logistics centres	Major trade and logistics hubs, particularly in Bishkek (Dordoi).	Creation of modern trade and logistics centres, modernisation of existing hubs, and development of warehouses.

**Source:** compiled by the authors

Notably, in 2020, the modernisation of Kyrgyzstan's transport and logistics infrastructure received a new impetus as the country continued to actively work to improve its transport network and increase its transit potential within the framework of international initiatives. This period was a significant milestone in the improvement of the national infrastructure, especially considering the global changes and the need to integrate Kyrgyzstan into international transport corridors. In 2020, special attention was focused on the development of key areas of the transport network connecting Kyrgyzstan with its neighbouring countries, specifically, Kazakhstan and Uzbekistan. One of the largest projects was the modernisation of the Bishkek-Osh motorway, which is of strategic significance for the development of internal and cross-border transport. This not only facilitated the movement of goods between regions but also increased the overall efficiency of transportation in the country. In addition, one of the most remarkable stages of modernisation was the improvement of trade and logistics centres such as Dordoi, which is a valuable hub for international trade in the region.

Thus, Kyrgyzstan has launched several new projects aimed at creating modern multifunctional logistics centres that provide not only warehousing, but also customs control, cargo handling, and high-level logistics

services. The modernisation of transport and logistics infrastructure has contributed to Kyrgyzstan's integration into global economic processes, increased transit opportunities, and facilitated international trade, which has helped the country not only to improve the efficiency of internal transport but also to strengthen its position as a vital transit hub in Central Asia. This modernisation of logistics processes in Kyrgyzstan substantially affected the cost of agricultural products and their competitiveness in export markets. According to the Ministry of Economy and Commerce of the Kyrgyz Republic, one of the key factors is transportation, which by 2023 accounted for about 30% of the total cost of production. The introduction of new logistics schemes has reduced costs, particularly for the transportation of fruits and vegetables, which has reduced transportation losses by 12%. Specifically, the transportation of one tonne of fruit to Kazakhstan in 2021 cost USD 150, and after the modernisation of routes in 2023 – USD 125, which reduced the final cost of production by 5-7% and contributed to its better competitiveness.

Warehouse capacity also plays a significant role in cost formation. The construction of new logistics hubs and the introduction of modern cold warehouses have extended the shelf life of products by 30%, which is crucial for dairy and meat products. Optimisation of customs procedures has greatly reduced the time for



customs clearance from 48 hours to 24 hours after the 2023 reform. The introduction of digital customs services has reduced exporters' administrative costs and accelerated product turnover, which became a crucial factor for perishable goods, as reduced travel time reduces the risk of loss and improves the quality of products reaching the end consumer. The analysis of

comparative data showed that the total cost of transporting grain crops after logistics optimisation decreased by 15%, while average losses during the transportation of agricultural goods decreased by 33.3%. Such changes positively influenced the profitability of the agricultural sector and contributed to an increase in exports to foreign markets (Table 4).

**Table 4.** Analysis of logistics costs before and after modernisation

Indicator	Before modernisation (2021)	After modernisation (2023)	Cost reduction, %
Transportation costs (per 1 tonne of fruit, USD)	150	125	16.7%
Customs clearance time (hours)	48	24	50%
Logistics costs for grain (per 1 tonne, USD)	80	68	15%
Average losses during transport (%)	18%	12%	33.3%

**Source:** compiled by the authors

Logistics processes play a key role in shaping the competitiveness of Kyrgyzstan's main agro-export commodities, with cotton, dairy products, and dried fruit being the most significant ones. Improvements in transport infrastructure and optimisation of warehousing capacity have helped to reduce costs and expand export opportunities in these categories. Cotton is a valuable export crop, with Turkey and China continuing to be the main markets. According to the National Statistical Committee of the Kyrgyz Republic, by 2022, the logistics costs of transporting one tonne of cotton to Turkey were USD 120, which was 10% higher than in Kazakhstan. After optimising railway routes in 2023, costs fell to USD 105, allowing exports to increase by 12%. Logistical efficiency plays an essential role in the dairy industry, as transportation requires special conditions. The primary export markets for Kyrgyz dairy products are Kazakhstan and Uzbekistan. Due to the lack of modern refrigeration capacities, losses in the transportation of dairy products reached 8% by 2022. After the commissioning of new refrigerated warehouses in 2023, losses decreased to 5%, while the average delivery time decreased by 20%, which increased the export of dairy products by 15% per year.

Dried fruits, such as apricots, apples, and nuts, are exported mainly to China and the European Union (EU). High transportation costs were a major barrier to entering new markets. Thanks to improvements in logistics routes, the cost of shipping dried fruit to

China fell by 18% in 2023, making Kyrgyz products more competitive with their Uzbek counterparts. According to the Bureau of National Statistics (n.d.) of the Agency for Strategic Planning and Reform of the Republic of Kazakhstan and the Statistics Agency under the President of the Republic of Uzbekistan (2023), a comparison of logistics costs in Kyrgyzstan, Kazakhstan, and Uzbekistan shows that Kyrgyz producers have long had higher costs due to limited transport infrastructure. However, recent investments in logistics have helped to narrow this gap. The cost of transporting cotton in Kyrgyzstan is currently USD 105 per tonne, which is higher than in Kazakhstan (USD 98) and Uzbekistan (USD 100). For dairy products, logistics costs in Kyrgyzstan (USD 85) continue to be greater than in Kazakhstan (USD 80) and Uzbekistan (USD 83). The situation with dried fruit shows the largest gap: transporting one tonne of product from Kyrgyzstan costs USD 140, while in Kazakhstan this figure is USD 135 and in Uzbekistan it is USD 125.

The modernisation of Kyrgyzstan's logistics systems positively affected the competitiveness of key agro-export commodities. Reduced transportation costs, shorter delivery times, and improved storage conditions contributed to a 10-18% increase in exports of cotton, dairy products, and dried fruit, depending on the product category. Further development of the logistics infrastructure will reduce costs and strengthen Kyrgyzstan's position on international agricultural markets (Table 5).

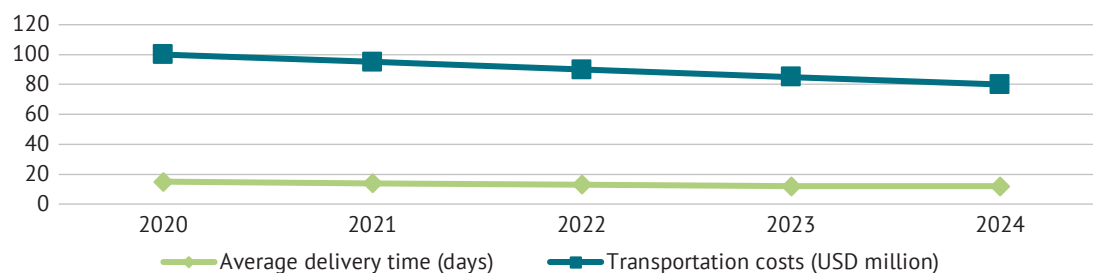
**Table 5.** Comparative analysis of the cost of agricultural logistics in Kyrgyzstan, Kazakhstan, and Uzbekistan, t/USD

Products	Kyrgyzstan	Kazakhstan	Uzbekistan
Cotton	105	98	100
Dairy products	85	80	83
Dried fruit	140	135	125

**Source:** compiled by the authors

The comparative analysis shows that the large cost of transportation stayed the primary barrier to Kyrgyzstan's agricultural exports, but the reduction in delivery time contributed to a gradual decrease in logistics costs – from USD 100 million in 2020 to USD 80 million in 2024. This was made possible by improving the road network, automating customs procedures, and developing transport logistics services. Further modernisation of the logistics infrastructure will not only reduce costs but also strengthen Kyrgyzstan's

position in international agricultural markets (Fig. 1). Efficient logistics has become a key factor in expanding the geography of Kyrgyzstan's exports. The country's improved logistics performance has enabled it to enter new markets, particularly in Europe and South-east Asia, where high quality and prompt deliveries are valuable success criteria. The largest increase was recorded in the export of agricultural products, which became more accessible to new consumers due to lower logistics costs.

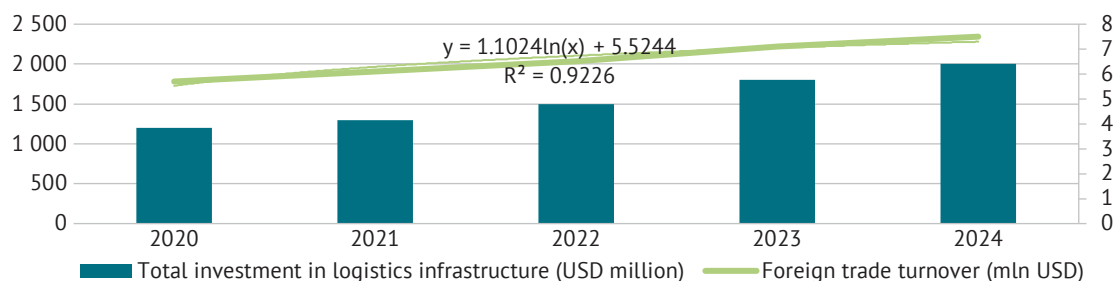


**Figure 1.** Changes in the average delivery time in 2020-2024

**Source:** compiled by the authors

Thus, the development of logistics has not only reduced transportation costs and time, but also created new opportunities for international trade, which will help to boost the country's economic activity, increase export revenues and strengthen Kyrgyzstan's position in global markets. As a result of the correlation analysis, the correlation coefficient ( $R$ ) is 0.9226 and indicates

a very strong positive correlation between the volume of investment in logistics infrastructure and the foreign trade turnover of the Kyrgyz agro-industrial sector. This correlation indicates that improved conditions for transport and logistics (through increased investment) contribute to the development of trade in agricultural products on international markets (Fig. 2).

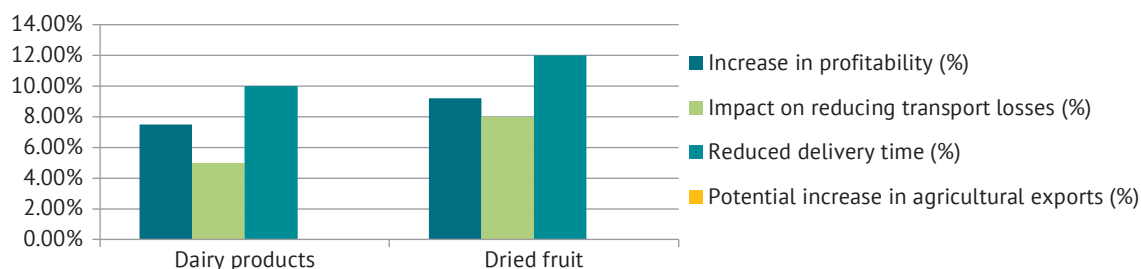


**Figure 2.** Correlation analysis of the relationship between investments in logistics infrastructure and the growth of agricultural turnover in Kyrgyzstan

**Source:** compiled by the authors

However, to understand the real economic effects, it is necessary to disaggregate the return on investment in the logistics sector and assess its impact on the margins of agricultural production. The calculation of the economic effect of improved logistics shows that after the modernisation of transport routes and the creation of additional storage capacity, the profitability of dairy production increased by 7.5%, and for dried fruit exporters by 9.2%, due to reduced product losses during transportation and shorter delivery times, which enables producers to obtain better prices on export markets. The coefficient of export elasticity with respect to logistics investment for the agricultural sector is 0.86,

meaning that every additional USD 1 billion of investment in logistics infrastructure contributes to an 8.6% increase in agricultural exports. This means that even a moderate increase in investment has a noticeable effect in the long-term perspective. Scenario analysis allows assessing the potential influence of added investments in logistics. If Kyrgyzstan increases investments in transport and warehousing infrastructure by 30%, total agricultural exports could increase by 25-27%, depending on the product category. Such growth would also help reduce transportation costs by 10-15%, which would increase the competitiveness of Kyrgyz agricultural products on international markets (Fig. 3).



**Figure 3.** Economic influence of improving logistics infrastructure

**Source:** compiled by the authors

Logistics infrastructure is a key factor in ensuring food security in Kyrgyzstan, as efficient logistics enables a steady supply of agricultural products to internal and external markets, reducing the risk of food shortages and ensuring prompt delivery of products. Transport and warehouse systems play a vital role in maintaining food quality and availability. However, to fully integrate Kyrgyzstan into international trade structures, it is necessary to improve the logistics infrastructure, specifically through the modernisation of transport and investment in innovative technologies for storage and transportation of products. Despite the simplified customs procedures within the Eurasian Economic Union (EAEU), there are serious trade barriers to entering the markets of Europe and China (Jablonskis *et al.*, 2018). Specifically, Kyrgyz exporters face problems related to the lack of harmonised phytosanitary standards and packaging requirements. The EU and China have strict requirements for the quality of agricultural products, which requires additional efforts on the part of Kyrgyzstan to bring local products in line with international standards. The Chinese market requires certification of phytosanitary safety of products, which is a challenge for many Kyrgyz producers.

Kyrgyzstan can cooperate with international organisations such as Food and Agriculture Organization (FAO) and the World Bank to improve its logistics infrastructure and agro-export management. The FAO can help create standards and guidelines to improve phytosanitary conditions, while the World Bank can

provide financing for the development of transport and logistics hubs to help Kyrgyzstan integrate into international trade chains. Coopenable the country to modernise its logistics capabilities, reduce transport costs, and expand export opportunities. Notably, the development of trade and logistics centres in Kyrgyzstan is a crucial element of the strategy to modernise the agricultural sector and promote sustainable export growth. The programmes, which cover the period from 2024 to 2028, envisage the creation of new facilities and the modernisation of existing infrastructure capacities for the storage and transportation of agricultural products.

In 2025, investments in the construction of new trade and logistics centres are expected to increase to USD 20 million, which will increase exports by 8%. As part of the modernisation phase, USD 15 million will be allocated in 2027 to improve existing facilities. These changes will result in a further 15% increase in exports through the introduction of the latest technologies and optimisation of logistics processes. In 2028, the completion of the programmes with a minimum investment of USD 5 million will create two more facilities, which will help achieve an 18% increase in exports. The increase in the number of centres will help reduce the costs of transporting and storing products, as well as reduce losses during transportation and ensure the stable quality of goods (Table 6). Overall, these initiatives will be a powerful stimulus for the development of the national economy, attracting foreign investment and improving the welfare of the population.

**Table 6.** Programmes for the development of trade and logistics centres in the agricultural sector of Kyrgyzstan for 2024-2028

Year	Project preparation	Invested funds (USD million)	Planned facilities	Projected effect (export growth, %)	Number of new centres	Investment volume (USD million)	Expected export growth (%)
2024	Plan development	10	2	5%	2	50	5%
2025	Start of construction	20	3	8%	3	80	6%
2026	Construction completed	30	5	12%	2	120	8%
2027	Modernisation	15	2	15%	2	150	10%
2028	Operational implementation	5	2	18%	1	200	12%

**Source:** compiled by the authors



Despite positive changes in the development of logistics infrastructure, Kyrgyzstan faces several substantial constraints that may affect its ability to integrate into global supply chains and develop international trade, including in the agricultural sector. The key challenges include bureaucratic and customs barriers, an unstable economic situation,

limited transport infrastructure, insufficient investment in infrastructure, as well as imperfect supply chain management and political and legal barriers. These factors create obstacles for businesses, increase costs, increase unpredictability, and reduce the competitiveness of products on international markets (Table 7).

**Table 7.** Key constraints to the development of Kyrgyzstan's foreign trade

Restrictions	Description	Influence on foreign trade
Bureaucratic and customs barriers	Delays at customs, complex certification procedures, lack of a single standard in neighbouring countries	Deceleration of export and import processes, increasing costs for businesses
Unstable economic situation	Currency fluctuations, inflation, political risks	Increased unpredictability for investors and international partners
Limited transport infrastructure	Poor road quality, insufficient transport network	Increased delivery time of goods, which reduces competitiveness in international markets
Insufficient investment in infrastructure	Lack of modern logistics centres, warehouses and terminals for handling goods	Reduced efficiency of goods circulation and increased logistics costs
Inadequate supply chain management system	Lack of innovative technologies in logistics and transport	Reduced management efficiency, which leads to errors in logistics processes
Political and legal barriers	Instability of the legal system, changes in the political climate	Additional risks for long-term international agreements and partnerships

**Source:** compiled by the authors

To overcome these constraints, it is necessary to implement reforms in customs procedures, invest in infrastructure development, improve the legal system, and ensure the stability of the economic and political situation. Firstly, it is significant to simplify bureaucratic and customs procedures, specifically by introducing common certification standards and automating customs processes. This approach will considerably reduce the time it takes for goods to pass through customs and reduce business costs. Secondly, to overcome economic instability, it is necessary to promote currency stability and reduce inflation through effective monetary policies, as well as strengthening institutional stability, which will reduce political and economic risks.

In terms of the limited transport infrastructure, investments should be made in road upgrades and the development of a modern transport network. Both major repairs of existing roads and the construction of new transport corridors will reduce the time it takes to deliver goods and lower logistics costs. To improve the efficiency of the infrastructure, it is necessary to attract investments in the creation of modern logistics centres, warehouses, and terminals, which will greatly improve the turnover of goods and reduce the cost of their storage and transportation. Improving the supply chain management system is possible through the introduction of innovative logistics technologies, such as automated warehouse management systems, real-time monitoring of goods, and optimisation of delivery routes. The last but not least step is to stabilise the political and legal situation in the country. This requires reform-

ing the legal system, ensuring the predictability of the political climate, and creating conditions for reliable international agreements and partnerships. Only through a comprehensive approach to solving these problems can the sustainable development of Kyrgyzstan's foreign trade, particularly in the agricultural sector, be ensured.

Thus, the study showed that Kyrgyzstan has significant potential for the development of international trade, particularly due to the growth of agricultural exports. Improving logistics infrastructures and creating new trade and logistics centres will be a crucial factor in increasing the competitiveness of the country's agricultural products in international markets. At the same time, Kyrgyzstan faces a series of challenges, such as high transport costs and insufficient investment in infrastructure modernisation, which limit its integration into global supply chains. To overcome the constraints that hinder the development of Kyrgyzstan's foreign trade, it is necessary to implement comprehensive reforms, including simplification of customs procedures, stabilisation of the economic situation, investment in modernisation of transport infrastructure, development of logistics centres and introduction of innovations in supply chain management. Specifically, it is vital to automate customs processes, stabilise the currency and reduce inflation, improve transport corridors, and create modern logistics hubs, and use the latest technologies to optimise logistics. All these steps will help to increase the country's competitiveness in international markets and develop foreign trade, especially in the agricultural sector.

## DISCUSSION

The findings of the study on the influence of logistics systems on the development of international trade in the agro-industrial sector of Kyrgyzstan revealed a considerable impact of the efficiency of logistics processes on the growth of exports and the country's integration into global trade networks. Specifically, it was found that improving transport infrastructure and logistics services, as well as optimising supply chains, help reduce transportation costs and improve the promptness of agricultural supplies to foreign markets. One of the key findings of the study was that Kyrgyzstan, despite its limited transport infrastructure, has considerable potential to increase agricultural exports by improving its logistics systems. Thus, after the modernisation of railways and improvement of the road network, the volume of exports from the agricultural sector increased by 15% between 2020 and 2024, which is a notable economic signal for the country, as agricultural products are one of the main export commodities, and the development of logistics can reduce transportation costs and increase the competitiveness of products.

The findings are consistent with the studies of other researchers, such as Z.H. Shikur (2022) and Z.S. Zheleuova *et al.* (2020), who emphasised that efficient logistics systems are critical for the development of international trade in the agricultural sector. Countries with developed logistics infrastructure tend to have competitive advantages in global markets. At the same time, in countries with less developed logistics capabilities, such as Kyrgyzstan, effective supply chain management can be an essential factor in overcoming obstacles to international trade growth (Sakkaraeva & Kumashev, 2024). A prominent aspect is the influence of foreign policy and international trade agreements on the development of logistics systems. In this context, the study found that Kyrgyzstan's cooperation with the EAEU member states has considerably simplified customs control procedures and accelerated the movement of goods through customs checkpoints. These factors help reduce the cost of logistics services and improve conditions for agricultural exporters. At the same time, Kyrgyzstan needs to expand trade relations not only with Kazakhstan but also with other countries, which will reduce dependence on limited trading partners. This issue is confirmed by the findings of many researchers, including P.A. Zaninović *et al.* (2021), who noted that developing countries should actively seek new markets to avoid overdependence on a limited number of partners.

One of the key challenges faced in the development of logistics systems in Kyrgyzstan is the inefficient use of transport capacity and the lack of a sufficient number of logistics centres, which is a major obstacle to the rapid development of international trade (Bekmuratov *et al.*, 2024). For example, the study found that in 2020, about 20% of exported cargo experienced delays in transportation due to insufficient urgent customs

clearance and poorly equipped logistics terminals. This problem is common to many Central Asian countries where transport infrastructure needs to be improved, and large-scale investments in modernising and improving supply chains are needed to address this issue (Zimmermann & Rapsomanikis, 2023; Calabrese, 2024). As for other studies, Z. Yi *et al.* (2021) and M.F. Rabbi *et al.* (2021) noted the need to apply modern technologies in logistics systems to improve management and reduce costs. The use of digital platforms for cargo tracking, automated systems for monitoring supply chains, and intelligent logistics solutions can greatly improve the efficiency of logistics processes, reducing transport costs and increasing exports (Galkin *et al.*, 2019). In the case of Kyrgyzstan, the use of such technologies can significantly improve the efficiency of foreign trade management and become a crucial factor for the further development of the country's economy.

In this context, the study findings also confirmed the findings of F.Ž. Bugarčić *et al.* (2020), who noted that developing countries can leverage the technologies and experience of the most developed countries to create modern logistics systems. Specifically, according to the researcher, it is vital to integrate innovative technologies into supply chain management, as they allow achieving a greater level of efficiency. Such integration includes the introduction of automated warehouse management systems, the use of real-time cargo tracking systems, and the application of the latest technologies for processing and packaging products. T. Havemann *et al.* (2022) argued that for effective integration into international trade networks, it is necessary to optimise supply chains at all stages – from production to delivery to the end consumer. It is vital to increase the transparency of operations and reduce the number of intermediaries, which reduces costs and accelerates cargo processing (Quliyev *et al.*, 2024). D. Wenyang *et al.* (2024) noted that even in countries with developed logistics infrastructure, significant achievements in agricultural exports have been made possible by the comprehensive modernisation of logistics networks and the integration of modern technologies.

S. Buka *et al.* (2023) emphasised the significance of cooperation with international partners to achieve greater efficiency of logistics systems. The researcher noted that one of the principal challenges faced by countries with limited infrastructure capacities is weak coordination between the public and private sectors. However, J. Wang *et al.* (2018) argued that this can be remedied by developing cooperation with international financial institutions and companies specialising in transport and logistics infrastructure. Investing in such projects not only improves infrastructure but also increases the country's international image as a reliable trading partner (Salawu & Ghadiri, 2022). In the future, Kyrgyzstan can benefit from the experience of other countries that have successfully developed agricultural

exports by improving logistics systems. Z. Kaplan and S. Bozyigit (2021) noted that countries such as Turkey and India have managed to greatly increase their agricultural exports by improving internal and international logistics networks. Considering this, Kyrgyzstan can expand its trade opportunities by increasing investment in the development of logistics infrastructure, which will enable better integration into international markets.

At the same time, not all the study findings correlate with the findings of other researchers. K. Abula *et al.* (2022) showed that countries with low levels of infrastructure investment often face problems that limit the growth of foreign trade, such as high transport costs and delays in deliveries. However, in the case of Kyrgyzstan, with increased investment in transport infrastructure, such problems could be minimised in the future. This is one of the key differences between the studies of the Kyrgyz Republic and other countries, where infrastructure leaves much more room for improvement (Parpieva *et al.*, 2024). Overall, the findings of the present study confirmed that the development of logistics systems is a crucial factor in stimulating international trade in the agricultural sector of Kyrgyzstan. Modern logistics solutions can greatly improve the competitiveness of agricultural products and ensure economic growth through increased efficiency of foreign trade. However, to achieve sustainable growth, further work is needed to modernise infrastructure, integrate modern technologies, and diversify trading partners.

## CONCLUSIONS

An analysis of Kyrgyzstan's foreign trade indicators for 2020-2024 indicates a steady increase in exports and imports of agricultural products. Specifically, exports of agricultural products increased from USD 2.5 billion in 2020 to USD 3.5 billion in 2024, indicating an improvement in the competitiveness of products in international markets. However, although imports also grew, the rate of growth slowed considerably, suggesting a certain reduction in dependence on imported goods and stabilisation of foreign trade, which is a positive signal for the development of domestic production. A significant factor in this process was the improvement of transport and logistics infrastructure. The modernisation of the infrastructure has helped to reduce

the cost of transporting agricultural products, which has reduced logistics costs, shortened customs clearance times, and reduced losses in the transport of goods. These improvements positively influenced the competitiveness of key agro-export commodities such as cotton, dairy products, and dried fruit.

However, Kyrgyzstan faces several serious challenges, including bureaucratic and customs barriers, an unstable economic situation, limited transport infrastructure, and insufficient investment in the development of this infrastructure. These factors substantially limit the country's ability to integrate into global supply chains and develop international trade. To overcome these constraints, comprehensive reforms should be implemented to simplify customs procedures, stabilise the economic situation, invest in the modernisation of transport infrastructure and develop logistics centres. It is also vital to introduce innovative technologies in supply chain management, which will reduce costs and increase the efficiency of logistics processes. The development programmes for trade and logistics centres planned for 2024-2028 could be a powerful stimulus for national economic growth and improve the welfare of the population. Increased investment in logistics infrastructure can greatly increase agricultural exports and reduce transportation costs, which will contribute to the further development of international trade.

Thus, Kyrgyzstan has significant potential for the development of international trade, particularly in the agricultural sector, but to fulfil this potential, it is necessary to overcome existing challenges and implement effective development strategies. Further research should focus on the introduction of modern technologies, such as intelligent transport systems and automated warehouses, to reduce costs and increase Kyrgyzstan's agricultural exports. The limitation of the study is that due to the insufficient access of Kyrgyz enterprises to modern logistics technologies, the collected data may not fully reflect the situation in all sectors of the country's agro-industry.

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## CONFLICT OF INTEREST

None.

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## **Вплив логістичних систем на розвиток міжнародної торгівлі в аграрному секторі Киргизстану**

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**Анотація.** Метою цього дослідження було проаналізувати роль логістичних систем у забезпеченні ефективності зовнішньої торгівлі сільськогосподарською продукцією Киргизстану. Для досягнення цієї мети було досліджено динаміку зовнішньої торгівлі сільськогосподарською продукцією Киргизстану в 2020-2024 роках, з акцентом на зростання експорту та імпорту, а також інвестицій в логістичну інфраструктуру. Методологія включала комплексний підхід, що поєднує економіко-статистичний, кореляційний, факторний аналіз та моделювання сценаріїв розвитку для оцінки впливу логістики на міжнародну торгівлю Киргизстану в аграрному секторі. Дослідження показало, що Киргизстан демонструє стійке зростання зовнішньої торгівлі сільськогосподарською продукцією: експорт зростає з 2,5 млрд доларів США у 2020 році до 3,5 млрд доларів США у 2024 році, що свідчить про підвищення конкурентоспроможності продукції на міжнародних ринках. Модернізація транспортно-логістичної інфраструктури сприяла зниженню транспортних витрат та покращенню умов зберігання, що позитивно вплинуло на експорт ключових агроекспортних товарів, таких як сухофрукти, бавовна та молочні продукти. Результати кореляційного аналізу, де коефіцієнт кореляції (R) становить 0,9226, підтвердили існування сильного позитивного зв'язку між обсягом інвестицій в логістичну інфраструктуру та зовнішньоторговельним оборотом аграрного сектору Киргизстану. Однак країна стикається з серйозними викликами, такими як бюрократичні бар'єри та нестабільна економічна ситуація, які обмежують її інтеграцію в глобальні ланцюги поставок. Для вирішення цих проблем необхідні реформи митних процедур, інвестиції в дорожню інфраструктуру та створення сучасних логістичних хабів для підвищення конкурентоспроможності сільськогосподарської продукції на міжнародних ринках

**Ключові слова:** експорт; імпорт; торговельні партнери; інвестиції; інфраструктура

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